May 1952 Pages 141-196

The Journal
of the
SOCIETY OF DYERS AND COLOURISTS

Volume 68 Number 5

CONTENTS

PROCEEDINGS OF THE SOCIETY—
Annual General Meeting 141
Annual Dinner 150
The Second George Douglas Lecture—Synthetic Fibres in Prospect and Retrospect (*Rowland Hill*) 150
COMMUNICATIONS—
A New Method for the Dyeing of Mineral Khaki (*E. H. Daruwalla and G. M. Nabar*) 168
Quantitative Estimation of Eulan CN, Mitin FF, and Lanoc CN in Wool (*R. S. Hartley, F. F. Elsworth, P. G. Midgley, and J. Barritt* 171
CORRESPONDENCE 176
NOTES 180
OBITUARY NOTICE 182
NEW BOOKS AND PUBLICATIONS 182
MANUFACTURERS' PUBLICATIONS AND PATTERN CARDS . 184
ABSTRACTS 185

THE SOCIETY OF DYERS AND COLOURISTS 19 PICCADILLY BRADFORD YORKS

For all wet processing

TEEPOL or LENSEX

★ EMULSIFICATION AND SUSPENSION

The efficiency of TEEPOL and LENSEX in the ready emulsification of oil and grease is due largely to their ability to effect, even at low concentrations and temperatures, a striking reduction in the interfacial tension between water in the scouring bath and the oil and grease present in the fibres. These high powers of emulsification are vital, both for the removal of natural oils and greases and for washing off the fibre lubricants applied during spinning and other processes.

TEEPOL and LENSEX, with their excellent suspending properties, ensure that physical soiling is not redeposited once it has been removed from the fibres, but is kept in suspension and carried off with the scouring liquor and rinsing water.

From scour to finish, use TEEPOL or LENSEX for all wet processing.

SHELL

SHELL CHEMICALS LIMITED, Norman House, 105-109 Strand, W.C.2. *Tel:* Temple Bar 4455
(DISTRIBUTORS)

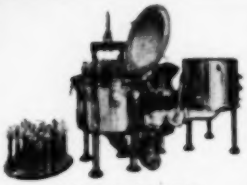
Divisional Offices: Walter House, Bedford St., London, W.C.2. *Tel:* Temple Bar 4455 ; 42 Deansgate, Manchester, 3. *Tel:* Deansgate 6451
Clarence Chambers, 39 Corporation St. Birmingham, 2. *Tel:* Midland 6954 ; 28 St. Enoch Square, Glasgow, C.1. *Tel:* Glasgow Central 9561
53 Middle Abbey Street, Dublin. *Tel:* Dublin 45775

TL 12

"TEEPOL" and "LENSEX" are Registered Trade Marks

PEGG Dyeing Machines

FOR LOOSE STOCK, HANKS, PACKAGES, PIECE GOODS, FABRIC AND HOSE. ALSO FINISHING MACHINES FOR ALL CLASSES OF CIRCULAR KNITTED AND WARP LOOM FABRICS AND GARMENTS. PRE-BOARDING AND FINISHING MACHINES FOR NYLON HOSE . . .



PACKAGE DYEING MACHINE

Constructed in stainless steel in four sizes from single-package samples to 488-package model.

PULSATOR HANK DYEING MACHINE

Stainless steel construction. Dyes all classes of wool, worsted, mixture and linen yarns. Capacities from 50 to 1,500 lbs.

YORKSHIRE PIECE GOODS DYEING MACHINE

For dyeing heavy or medium woollen or worsted piece goods in rope form. Built in stainless steel in three sizes.

ROTARY DYEING MACHINE

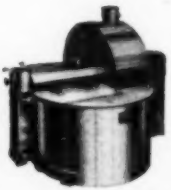
The standard machine for dyeing nylon, pure silk and rayon hose. Stainless steel construction in 25, 50, 100 and 200 lbs. capacities.

SILK TYPE DYEING MACHINE

Shallow bath type for dyeing all types of silk or rayon fabrics in rope form. Four capacities. Stainless steel construction.

LOOSE STOCK DYEING MACHINE

For all types of loose wool and other loose stock. Built in stainless steel in two capacities 100 250 lbs. and 200 600 lbs.



OVAL TYPE PADDLE DYEING MACHINE

For dyeing hose, garments, hats and loose articles. Built in stainless steel in three sizes.

A Company of the Mellor Bromley Group

SAMUEL PEGG & SON · BARKBY RD · LEICESTER · ENGLAND

SP22B

Metachrome Brown 6G

and

Metachrome Brown EB

Booklets, Samples and Technical assistance on application.

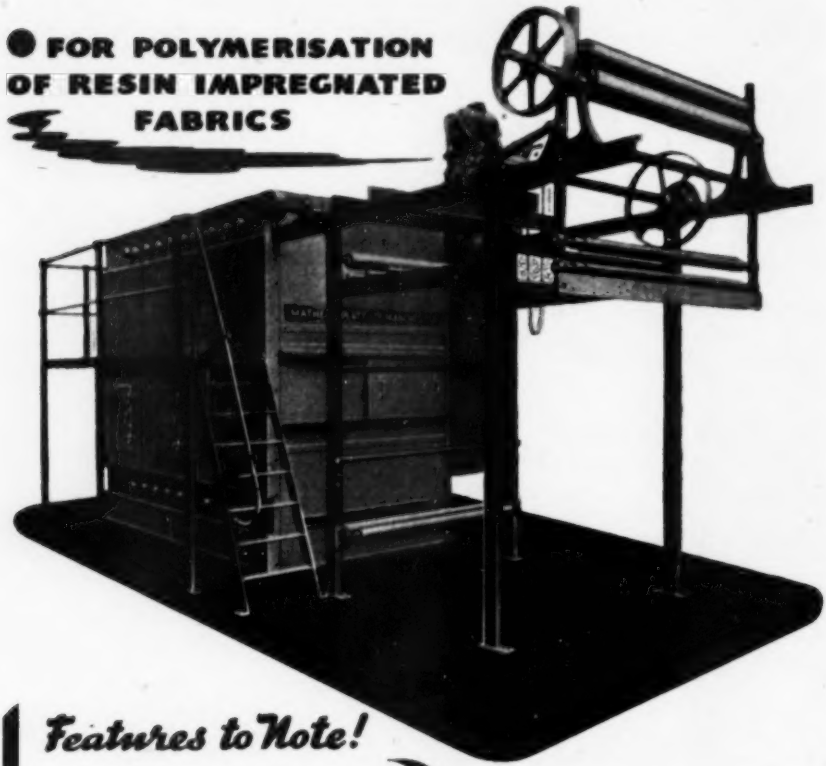
BROTHERTON & COMPANY LTD

CITY CHAMBERS

♦ LEEDS 1 ♦

Telephone: LEEDS 29321. *Telegrams:* BROTHERTON, LEEDS 1.

● FOR POLYMERISATION OF RESIN IMPREGNATED FABRICS



Features to Note!

- Exceptionally high production
- Adequate polymerisation with soft or firm handle as required
- Electrical, gas or steam heating elements as required
- Efficient and automatic temperature control — initial temperature quickly obtained
- Easy access with efficient insulation
- Compact and operative as a separate unit or part of a range
- Efficient air filtration
- Minimum length tension
- Versatile — water repellent and permanent glaze finish

THE MATHER & PLATT

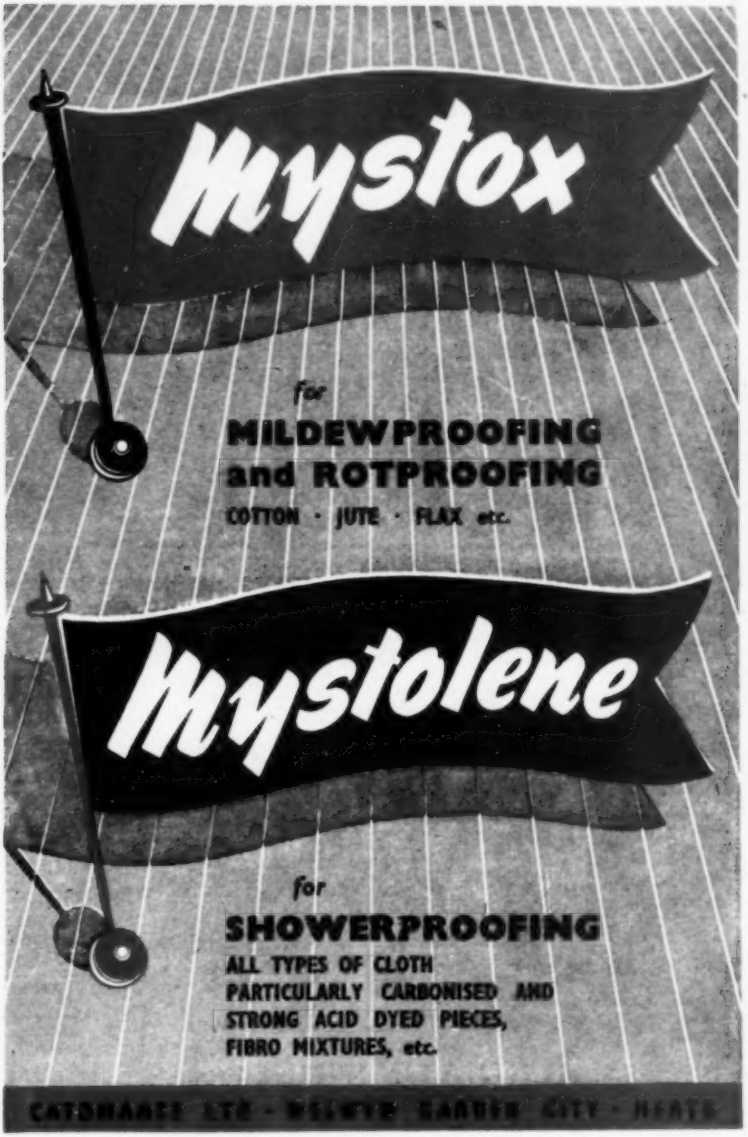
BAKING STOVE

A FINE MACHINE...

Write now for details of the M & P Service to the Textile Trade

MATHER & PLATT LIMITED

PARK WORKS : MANCHESTER 10


Mystox
for
MILDEWPROOFING
and ROTPROOFING
COTTON · JUTE · FLAX etc.
Mystolene
for
SHOWERPROOFING
ALL TYPES OF CLOTH
PARTICULARLY CARBONISED AND
STRONG ACID DYED PIECES,
FIBRO MIXTURES, etc.

QUICK RELEASE

FROM ALL MIXING TROUBLES..

Here is a new type of coupling for Kestner Portable Electric Stirrers and Mixers. A quick action chuck—that allows the release of the shaft by one turn of the wrist — no spanner is necessary! When replaced, however, it is rigid and self-locking.

This is only one of many new and exclusive Kestner features that are described in our recent publication — Leaflet No. 287

Have you had a copy?

KESTNER

PORTABLE *ELECTRIC* STIRRERS

KESTNERS *Chemical Engineers* 5 GROSVENOR GARDENS LONDON SW1

AIL

MANUTEX

the ideal thickener for textile printing pastes

A UNIFORM PRODUCT

SOLUTIONS MADE WITHOUT BOILING • SIEVING OF SOLUTIONS UNNECESSARY

EASILY WASHED OFF LEAVING SOFT HANDLE

EXCELLENT COLOUR YIELD AND PENETRATION

VISCOSITY AND FLOW CHARACTERISTICS CAN BE VARIED OVER A WIDE RANGE

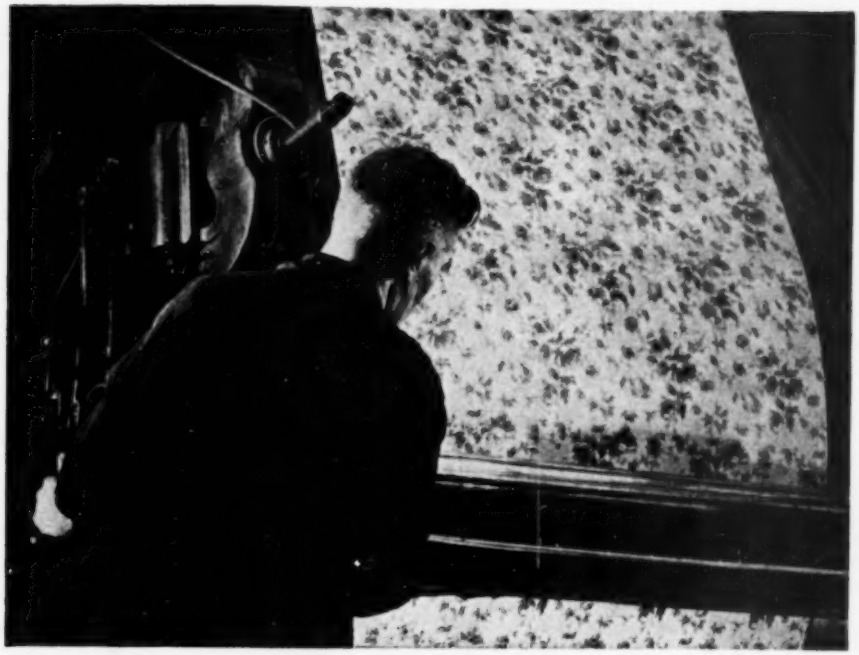
Manutex can be used in most styles of printing and full technical data with formulae and samples will be sent on request

ALGINATE INDUSTRIES

LIMITED

Walter House, Bedford Street, Strand, London, W.C.2

TELEPHONE: TEMPLE BAR 0451



LOOKING ON THE BRIGHT SIDE

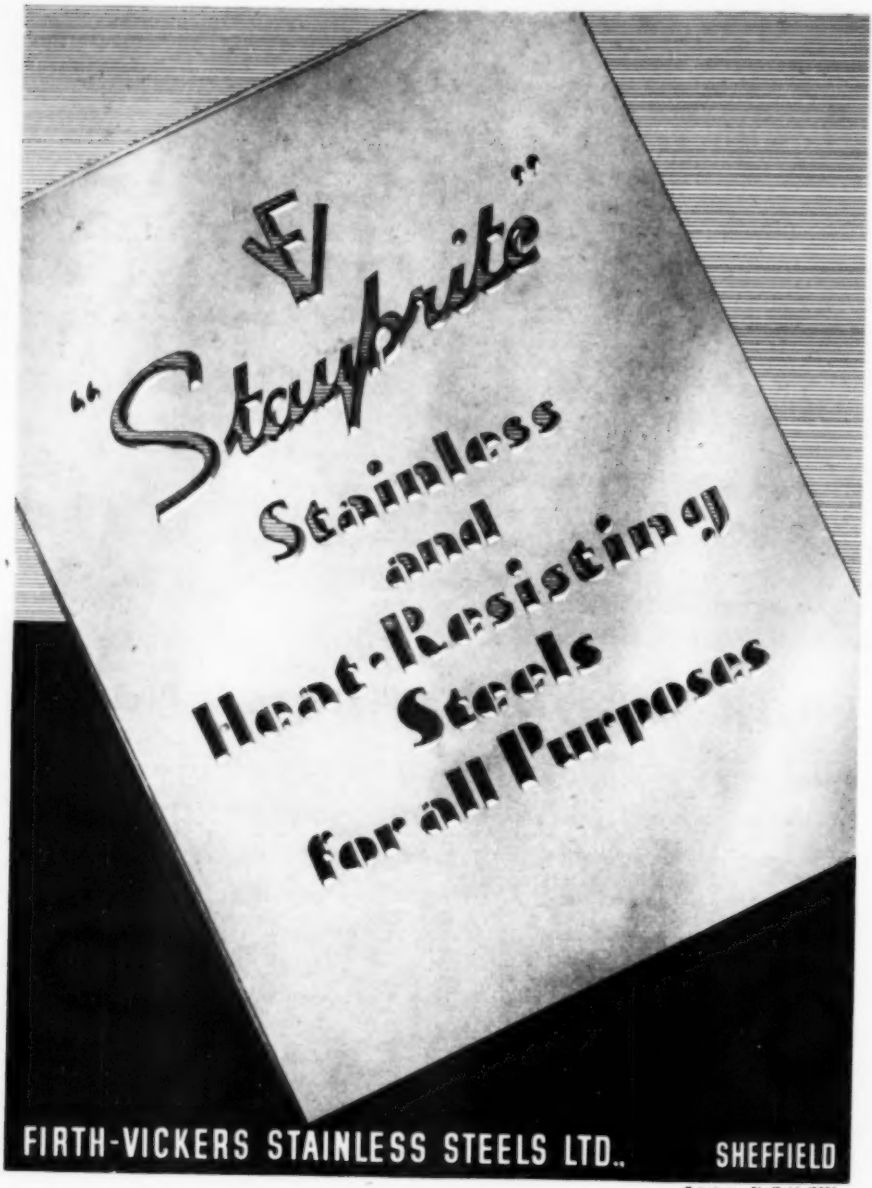
Whether your problem is scouring before or after printing or after dyeing, or whether it is dyeing in the piece or by the hank, the chief enemy of good results is lime soap. Lime soap on the fibre produces a harsh feel, streaky results and poor colours. Calgon (Sodium Metaphosphate) used in scouring and dyeing gives better and brighter colours with more certain results, and the piece handles better. The Cotton, Rayon, Silk and Wool industries are finding life much brighter with Calgon. Write for a copy of "Calgon in the Textile Industry"

CALGON

for better dyeing and scouring

ALBRIGHT & WILSON LTD · *Water Treatment Department*
49 PARK LANE · LONDON · W·1 · *Telephone:* GROsvenor 1311 · *Works:* Oldbury & Widnes

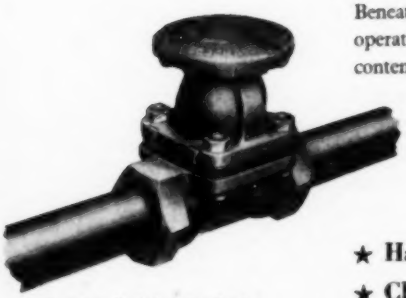
TMW 183


"Staybrite"
Stainless
and
Heat-Resisting
Steels
for all Purposes
FIRTH-VICKERS STAINLESS STEELS LTD.. SHEFFIELD
Telephone Sheffield 42051

St. Paul's Cathedral from the Thames South Bank

Dominating the Pipelines of Industry as Wren's masterpiece dominates the Skyline of London

SAUNDERS DIAPHRAGM VALVES



Saunders Technical handbooks describe the many applications

Beneath the domed bonnet of a Saunders Valve the operating mechanism is isolated from the pipeline contents by the flexible and impervious closure diaphragm. Thus, however dangerous or delicate the fluid, it is safely and surely controlled without harm to the valve or contamination of the fluid.

- ★ **Handwheel Operation (as illustrated)**
- ★ **Chainwheel Operation**
- ★ **Lever Operation (Quick Action)**
- ★ **Pressure Operation**

SAUNDERS VALVE CO LTD CWMBRAN MONMOUTHSHIRE

Review of Textile Progress

Volume 2

Compiled and published jointly by the Textile Institute
and the Society of Dyers and Colourists

Editors

W J HALL
A.R.C.S B.Sc

C J W HOOPER
Ph.D D.I.C A.R.C.S

The Textile Institute and the Society of Dyers and Colourists have jointly published a Review of Textile Progress, Volume 2 relating particularly to the year 1950. There are 25 contributors in the Review and the authors are experts in the various sections for which they are responsible

£1 5s 0d

(A few copies of Vol. 1, the 1949 issue, are still available, price £1 0s 0d)

Post free from
THE TEXTILE INSTITUTE 10 BLACKFRIARS STREET MANCHESTER 3
Telephone BLAckfriars 1457/8

CONFERENCE

"THE TINCTORIAL ARTS TO-DAY"

Bound volume of the Proceedings, containing both papers and discussions, at £1 5 0 (Members of the Society are entitled to a single copy at 15/-)

Orders should be sent to

THE SOCIETY OF DYERS AND COLOURISTS 19 PICCADILLY BRADFORD

try Carbowax compound PF-45

TRADE MARK

a ***NEW*** *modified polyethylene glycol*

- As a sizing, lubricating and binding agent in textile compounds.
- As a binder in ceramics, chalk, crayons, sand moulds, metal powder, and detergent cakes.
- As a lubricant in paper and textile calendering operations.

BECAUSE IT HAS:

1—Remarkable toughness and resilience.
2—Flexibility and lubricity.
3—Excellent adherence to most surfaces, such as glass, metal, and textile fibres.

CARBOWAX compound PF-45 is available from Carbide and Carbon Chemicals Company of the U.S.A in commercial quantities as a 50 per cent. aqueous solution, which facilitates application and handling.

Write to-day on your letterhead to Section 3-G for more information

"Carbowax" is a trade mark of Union Carbide and Carbon Corporation

CARBIDE AND CARBON CHEMICALS COMPANY

UNITED KINGDOM DISTRIBUTORS

GENERAL METALLURGICAL & CHEMICAL LTD

120 MOORGATE LONDON E C 2

Branch Office 62 Market Street Manchester 1

For more than forty years....

the mark B.D.H. has been a symbol of pre-eminent quality and service to chemists and pharmacists alike. Efficient distribution · comprehensive stocks of standard pre-packed chemicals · thorough analytical control of production · publication of informative literature · the services of technical representatives · these, together with the B.D.H. standards of purity, lead more and more laboratories to rely on B.D.H.

Reagents and Indicators 'AnalaR' Chemicals
Concentrated Volumetric Solutions
Testing Outfits Materials for Microscopy
Organic and Inorganic Chemicals for Laboratory use

B.D.H.

THE BRITISH DRUG HOUSES LTD. B.D.H. LABORATORY CHEMICALS GROUP **POOLE, DORSET**

Telephone Poole 962 (6 lines) *Telegrams* Tetradome Poole

LC/P/1

The Journal of the Society of Dyers and Colourists

(Subscription rates for non-members £4 per annum, post free)
(Abstracts section only printed on one side of paper—£1 10s 0d per annum)

NOTICE TO MEMBERS AND SUBSCRIBERS

Readers requiring *general information* regarding the Official Notices, List of Officers of the Society, etc. should consult pages 1–6 of the January 1952 and pages 253–256 of the July 1951 issues of the *Journal*, or write to *The General Secretary*, The Society of Dyers and Colourists, 19 Piccadilly, Bradford, Yorkshire (*Telephone* Bradford 25138–9). *Editorial Communications* should be addressed to *The Editor*, at the same address.

Forthcoming Papers

The following papers have been accepted by the Publications Committee, and will appear in future issues of the *Journal*—

LECTURES

The Continuous Dyeing of Vat Dyes
J. Ardron, M. R. Fox, and R. W. Speke

A New Method for the Application of Oxidation Blacks
C. Zuber and B. Jomain

COMMUNICATION

A Study of the Alkali Solubility Test for Determining the Degree of Damage in Wool
K. Lees and F. F. Elsworth

ADDRESSES WANTED

Alexandian, V. D., formerly of 5 Coningswath Road, Carlton, Nottingham
Josephson, C., formerly of c/o Silknit Ltd., 400 Sidney Road, Durban, South Africa
Justice, A., formerly of 35 Cumberland Avenue, Liverpool
Leman, R., formerly of 12 Ballerat Street, Levenshulme, Manchester 19
Marriott, F. W., formerly of 49 Woodcot Avenue, Baildon, Yorks
Thitchener, C. R., formerly of 29 Moorland Avenue, Leeds 6

MEMBERS' CHANGES OF ADDRESS

Bashlow, H. I., formerly of Rhode Island, to 813 First Avenue, Albany, Ga., U.S.A.
Butterworth, K., formerly of Bury Road, to 849 Rochdale Road, Slattocks, Rochdale
Colmins, A. I., formerly of Manchester, to c/o Fabrica de Tejidos La Union, Casilla 2066, Lima, Peru
Crossley, J. V., formerly of Herts., to 4 Blythswood Square, Glasgow
Dunn, D. A., formerly of Woodthorpe, to 23 Florence Road, Thorneywood, Nottingham
Gaukroger, L.S.M. G. A., formerly of Halifax, to P/KX732897, 21A Mess., H.M.S. *Theseus*, c/o G.P.O., London
Khin, Miss K., formerly of Rangoon, to c/o Mrs C. Lwin, Superintendent, Saunders Weaving Institute, Amarapura, Burma
Leyine, W. N., formerly of Birkdale, to 3 Deyne Avenue, Prestwich, near Manchester
Mehta, S. S., formerly of Salford, Lancs., to Oomer Park, Warden Road, Bombay 26, India
Respinger, A. E., formerly of Australia, to 4 Clyde Road, Douglas, Lanarkshire, Scotland
Wills, C., formerly of Quebec, Canada, to 1915 Sunset Avenue, Apartment C, Utica, New York State, U.S.A.

PISCES *(the Fishes)*

a constellation associated, like Capricornus, with the great mass of stars known as the Pegasus Region, is usually called the "Fishes".

The skill of the Dyer is implemented by the quality of the Colours used, and for excellent results Sandoz Specialty Dyestuffs make a full contribution.

A Recent Introduction:
ALIZARINE LIGHT VIOLET RS

Sandoz PRODUCTS LTD
BRADFORD

COLOUR FOR NYLON

Nylon materials for corsetry and lingerie, normally dyed in delicate pastel colours, must be fast to perspiration and must withstand gentle but frequent washing. **Dispersol, Duranol and Multamine** dyestuffs fully meet these requirements.

There is an I.C.I. dyestuff for every type of nylon material

For information please write to

ICI IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1

A.210

THE JOURNAL
OF THE
Society of Dyers and Colourists

Volume 68—Number 5 MAY 1952 *Issued Monthly*

Proceedings of the Society

Annual General Meeting

The 68th Annual General Meeting of the Society of Dyers and Colourists was held at the Queens Hotel, Leeds, on Friday, 28th March 1952, at 4.45 p.m., the President (Mr. FRED SCHOLEFIELD) being in the chair, and about 50 members of the Society being present.

The General Secretary (Dr. C. J. W. HOOPER) read the minutes of the 67th Annual General Meeting, which were accepted as a correct record on the motion of Mr. H. TURNER, seconded by Mr. J. PORTER; and the minutes of an Extraordinary General Meeting held on 1st November 1951, which were accepted as a correct record on the motion of Mr. C. O. CLARK, seconded by Mr. J. V. SUMMERSGILL.

REPORT OF THE COUNCIL

The vigorous activity of the Society has been maintained during the year ended 31st December 1951, and the membership has shown a net increase. Members are again strongly urged to bring to the notice of suitable candidates the benefits to be gained from membership of the Society.

The loss by death of eighteen members has been reported during the year, including Mr. J. Baddiley, a Perkin medallist and one to whom the dye industry of this country owes so much; Mr. J. T. Hodgson, who had been a member for fifty-three years; and Mr. S. Heap, who had served as Chairman of the Manchester Section and as an Ordinary Member of Council.

It is a special pleasure to record that five more members have now completed fifty years' membership of the Society, viz. Messrs. E. Clayton, L. Emerson, J. R. Hannay, H. W. Martin, and R. J. Steele, M.B.E. Mr. Clayton served the Society for many years as Editor of the *Journal*, and Mr. Hannay is a member of the Publications Committee.

Mr. F. Scholefield was re-elected President in March 1951, and by the manner of his presiding over the public meetings of the Society has added to its prestige and has served the Society well by his assiduous and able chairmanship of Council. Council is gratified that the office of President-elect has been filled by Mr. H. H. Bowen, to whom the Society is indebted for service in many ways and especially for his chairmanship of the Publications Committee for many years. Council is especially pleased that Mr. G. E. Holden, C.B.E., who preceded Mr. Scholefield as President, has now fully recovered from his illness.

The Sections continue their active life, and attendances at lecture meetings and social gatherings have been well maintained.

Relations with the Textile Institute and other similar organisations have remained cordial, and the Society has closely co-operated with the Institute in the production of the *Reviews of Textile Progress*, the second volume of which was published at the end of the year. This joint enterprise appears to be filling a real gap in the literature of textile and tinctorial progress. Close contact is maintained also between Sections of the Society and local sections of other bodies by the holding of joint meetings and the publication of joint syllabuses of scientific meetings in a given area.

The Society was officially represented at the 30th Annual Convention of the American Association of Textile Chemists and Colorists, held in New York in October 1951, by Mr. G. S. J. White, who presented a specially bound volume of the *Symposium on Photochemistry in relation to Textiles*. Mr. White's reception was of the friendliest, and his visit occurred at a time when important discussions on the supply of paper for the Second Edition of the *Colour Index* were in progress, and proved most valuable to the Society. At the 24th Congress of the Association des Chimistes de l'Industrie Textile, held in Paris in September 1951, the Society was represented by Messrs. J. Boulton and E. A. Swift, who were warmly welcomed, and were requested to transmit the cordial greetings of the A.C.I.T. to the Society and its President. In May 1951 the Institut Textile de France organised at Lille a Congrès International de la Recherche Scientifique appliquée à l'Industrie Textile, at which papers were given by several members of the Society, including Mr. W. J. Marshall, Dr. R. H. Peters, Mr. J. M. Preston, Professor J. B. Speakman, and Dr. D. Traill. Greetings have been exchanged also with the Nederlandsche Vereeniging voor Textiel-Chemie and the Associazione Italiana di Chimica Tessile e Coloristica.

FINANCE COMMITTEE—This Committee has met nine times during the year, and has had to consider,

Balance Sheet as at 31st December 1951

31.12.50	SURPLUS AND LIABILITIES	£ s. d.	£ s. d.
	SURPLUS AND DEVELOPMENT		
	Balance of Accumulated Funds	26,616 16 2½	
	Less Accumulated Expenditure on *New Colour Index*	4,269 0 8½	
20,977			22,347 17 6
1,850	FOUNDATION FUND		1,850 13 0
100	KNECHT MEMORIAL FUND		100 0 0
2,000	GEORGE DOUGLAS LECTURE FUND		2,000 0 0
	AMOUNTS RECEIVED IN ADVANCE		
96	Subscriptions		2,110 10 11
	CURRENT LIABILITIES		
1,714	Sundry Creditors per Schedule		3,168 19 9
£28,837			£31,578 1 2

31.12.50	ASSETS	£ s. d.	£ s. d.
	DEVELOPMENT ACCOUNT INVESTMENTS		
17,600	As per Schedule (at cost)		19,382 17 5
	(Market Value — £16,981)		
1,850	FOUNDATION FUND INVESTMENTS		
	As per Schedule (at cost)		1,850 13 0
	(Market Value — £1,841)		
100	KNECHT MEMORIAL FUND INVESTMENTS		
	As per Schedule (at cost)		100 0 0
	(Market Value — £84)		
	GEORGE DOUGLAS LECTURE FUND INVESTMENTS		
2,000	As per Schedule (at cost)		2,000 0 0
	(Market Value — £1,537)		
	CURRENT ASSETS		
36	Cash in Hand	41 10 9	
264	Cash in Bank	512 11 0	
2,456	Debtors per Schedule	4,004 2 10	
1,963	Stocks per Schedule	3,146 14 0	
4,719			7,704 18 7
	FIXED ASSETS		
	Furniture and Equipment per Schedule		
69	Library	65 2 6	
392	General	376 9 8	
107	*New Colour Index*	98 0 0	
568			539 12 2
£28,837			£31,578 1 2

H. JENNISON, *Honorary Treasurer*
JOHN BARRITT, *Honorary Secretary*

AUDITORS' REPORT

We have examined the above Balance Sheet with the Books and Documents of the Society produced to us.
In our opinion the above Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the Society's affairs according to the best of our information and the explanations given to us and as shown by the Books of the Society.

RAWLINSON, GREAVES & MITCHELL
Chartered Accountants
Auditors

10th January 1952
Bradford

GENERAL REVENUE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER 1951

31.12.50	EXPENDITURE	£ s. d.	£ s. d.
	To GENERAL OFFICE		
438	Printing and Stationery	489 14 8	
148	Postages	156 5 3	
1,403	Salaries and Wages	1,544 10 0	
201	Rents, Rates, and Insurances	162 12 0	
35	Electricity and Heating	42 19 7	
79	Telephone	66 4 9	
17	Bank Charges	19 11 0	
63	Audit and Accountancy	63 0 0	
40	Travelling Expenses	46 2 5½	
	Sundry Expenses—		
	Medal and Awards 149 6 4		
	Miscellaneous Committees' Expenses 98 7 6		
391	Sundries 58 0 5½	305 14 3½	
7	Investment Charges (Midland Bank Executor & Trustee Co. Ltd.)	9 8 0	
2,932		2,906 2 0	
693	" SECTIONAL EXPENSES	721 18 8½	
	" DEPRECIATION ON GENERAL OFFICE FURNITURE	49 0 0	
47			
	" MERCER LECTURE EXPENSES	43 15 6	
	Less Donation	20 0 0	
39		23 15 6	
	" JOURNAL		
5,991	Printing and Publishing	7,836 4 10	
558	Postages	529 11 2	
930	Editorial Charges	914 15 10½	
201	Own Journals	251 14 1	
303	Abstractors' Fees and Book Reviews	243 8 9	
7	Miscellaneous Publications	1 6 2½	
29	Rent, Rates, and Insurance	78 10 0	
17	Electricity and Heating	20 17 2	
31	Telephone	24 6 1	
73	Printing and Stationery	53 0 11	
9,154		9,953 15 1	
	" ANNUAL MEETING AND DINNER		
	Meeting	27 15 8	
102	Dinner	63 6 8½	91 2 4½
40	" DONATIONS AND SUBSCRIPTIONS	36 4 0	
	" FREIGHT, PACKAGES AND INSURANCE	5 12 9	
67	" REPAIRS AND RENEWALS	33 15 0	
	" LEGAL EXPENSES	25 5 0	
41	" LIBRARY UPKEEP	40 7 2	
11,751		13,886 17 7	
2,850	" SURPLUS FOR THE YEAR TO ACCUMULATED FUNDS	1,248 4 7½	
£14,601		£15,135 2 2½	

31.12.50	INCOME	£ s. d.	£ s. d.
	By SUBSCRIPTIONS		
4,610	Members	4,788 1 6	
69	Juniors	62 18 2	
4,679			4,850 19 9
	" JOURNAL ACCOUNT		
2,991	Sale of Journals and Reprints	3,283 8 3½	
—	" Miscellaneous Publications	49 19 2	
6,019	" Advertisements	6,398 18 8	
9,010		9,732 6 1½	
78	" STOCK—INCREASE OR DECREASE IN STOCK OF JOURNALS	80 10 0	
9,088			9,051 16 1½
102	" DONATIONS		152 2 6
512	" DIVIDENDS ON INVESTMENTS (Gross)		480 4 4
£14,601			£15,135 2 2½

SCHEDULE OF DEVELOPMENT ACCOUNT INVESTMENTS

	Balances 1950		Alterations		Balances 1951		Market Values 1950		Market Values 1951	
	£ s. d.		£ s. d.		£ s. d.		£		£ s. d.	
£2,763 3s. 8d. 3% British Transport Guaranteed Stock 1978/88	2,598 17 0				2,598 17 0		2,528		2,141 9 4	
£750 2½% Funding Stock 1956/61	750 0 0				750 0 0		731		690 0 0	
£546 3½% Conversion Loan	557 0 0				557 0 0		525		447 14 5	
£1,255 2½% Defence Bonds	1,255 0 0				1,255 0 0		1,255		1,255 0 0	
£2,749 16s. 0d. 3% Savings Bonds 1960/70	2,750 0 0				2,750 0 0		2,715		2,399 4 0	
£750 2½% Exchequer Bonds 1955	750 0 0				750 0 0		762		747 3 9	
500 National Savings Certificates 15/- units 7th Issue	375 0 0				375 0 0		375		375 0 0	
£2,000 3% British Gas Stock 1990/95	2,000 0 0				2,000 0 0		1,825		1,545 0 0	
£2,017 11s. 6d. 3% Treasury Stock 1966 or after	1,957 1 0				1,957 1 0		1,695		1,402 4 3	
£901 3s. 6d. 3% Southern Rhodesia 1971/73	910 13 9				910 13 9		670		701 9 10	
York County Savings Bank	2,000 0 0		489 11 8	Invested during year	2,489 11 8		2,000		2,489 11 8	
£1,500 12s. 9d. 3% British Electricity Guaranteed Stock 1968/73	1,495 19 0				1,495 19 0		1,451		1,271 15 10	
Post Office Savings Bank	– – –		500 0 0	Invested during year	500 0 0		–		500 0 0	
£1,000 Chesterfield Corporation 3% Stock 1960	– – –		993 15 0	Invested during year	993 15 0		–		955 0 0	
	£17,399 10 9		£1,983 6 8		£19,382 17 5		£16,754		£16,980 13 1	

SCHEDULE OF DEBTORS

	31.12.50			31.12.51		
	£	s.	d.	£	s.	d.
Rates and Insurances in advance	26	5	4	29	1	8
Income Tax Repayment due	59	10	8	94	10	3
Journals	476	19	9	880	8	5
Advertisements	1,748	14	0	2,022	3	6
Fastness Tests	26	6	4	65	5	6
Wool Dyeing	7	12	9	83	13	11
"Replika" *Colour Index* and Supplement	394	18	6	432	14	11
Dyeing Symposium	6	5	9½	28	14	8
Light Symposium	26	17	1½			
Reprints	47	18	7	81	14	4
Identification of Dyes	11	4	4	40	2	3
Abstracts	–	–	–	5	2	6
Subscriptions and Donations	–	–	–	150	0	0
Textile Institute	–	–	–	36	17	10
Miscellaneous Publications	–	–	–	1	16	1
Tinctorial Conference	–	–	–	5	2	6
Sundries	4	5	0	56	14	6
	£2,356	1	1	£4,004	2	10

SCHEDULE OF CREDITORS

	£	s.	d.	£	s.	d.
Printing and Stationery	3	16	0	4	8	5
Accountancy and Professional Charges	106	0	0	63	0	0
General Expenses	82	18	9	130	6	0
Sectional Expenses	6	8	6	13	14	6
Sundry Publications	14	2	6	35	15	4
Journal Expenses—						
Printing and Publishing	1,370	10	4	2,776	13	2
Postages	108	11	5	165	19	4
Abstractors' and Book Reviewers' Fees	2	10	0	–	–	–
Amounts received in advance	12	19	3	10	11	6
Royalties	–	–	–	28	11	6
	£1,713	18	9	£3,166	19	9

SUMMARY OF STOCK

	£	s.	d.	£	s.	d.
Fastness Tests, Materials, etc.	93	2	6	1,518	4	5
Journals	583	4	6	500	2	6
Light Symposium	38	15	10	23	9	0
"Replika" *Colour Index* and Supplement	761	12	0	307	17	9
Identification of Dyes	96	8	9	38	10	5
Wool Dyeing	–	–	–	613	17	5
Stationery	–	–	–	144	12	6
	£1,863	3	10	£3,146	14	0

SCHEDULE OF FOUNDATION FUND INVESTMENTS

	Balances 1950	Balances 1951	Market Values 1950	Market Values 1951
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
£1,245 2½% Defence Bonds	1,245 0 0	1,245 0 0	1,245 0 0	1,245 0 0
1,000 National Savings Certificates 10/- units 8th Issue	500 0 0	500 0 0	500 0 0	500 0 0
£68 8s. 6d. 3% Savings Bonds 1960/70	69 9 0	69 9 0	67 0 0	59 14 0
Midland Bank Ltd. (Cash awaiting investment—No. 2 Account)	36 4 0	36 4 0	36 4 0	36 4 0
	£1,850 13 0	£1,850 13 0	£1,848 4 0	£1,840 18 0

SCHEDULE OF FURNITURE AND FITTINGS

	General		New "Colour Index"		Library	
	1950	1951	1950	1951	1950	1951
	£	£ s. d.	£	£	£	£ s. d.
Balance 1st January 1950	429	391 19 8	118	107	–	68 17 8
Plus Additions	60	28 10 0	–	–	71	3 5 0
	489	420 9 8	118	107	71	72 2 8
Less Sales	50	– – –	–	–	–	– – –
	439	420 9 8	118	107	71	72 2 8
Less Depreciation at 10%	47	42 0 0	11	11	3	7 0 0
Balances 31st December 1951 per BALANCE SHEET	£392	£378 9 8	£107	£96	£68	£65 2 8

GEORGE DOUGLAS LECTURE FUND INVESTMENTS

	Balances 1950	Balances 1951	Market Values 1950	Market Values 1951
	£	£	£	£ s. d.
£1983 17 0 3% British Transport Stock, 1978/88	£2,000	£2,000	£1,815	£1,537 9 8

KNECHT MEMORIAL FUND INVESTMENTS

	Balances 1950	Balances 1951	Market Values 1950	Market Values 1951
	£	£	£	£ s. d.
£98 16 6 3% Southern Rhodesia Stock 1971/73	£100	£100	£96	£68 10 2

SUNDRY ACCOUNTS FOR THE YEAR ENDED 31ST DECEMBER 1951

FASTNESS TESTS, etc.

EXPENDITURE	£ s. d.	£ s. d.	INCOME	£ s. d.	£ s. d.
To STOCK OF CLOTH 1ST JANUARY 1951	93 2 6		By SALES		
" MATERIALS	1,436 4 6		Grey Scale	9 10 0	
" POSTAGES, ETC.	6 10 7		Reports	15 17 9	
" SURPLUS TO ACCUMULATED FUNDS	141 13 9		Materials	161 6 9	186 14 6
			" STOCK 31ST DECEMBER 1951		1,490 17 10
	£1,677 12 4				£1,677 12 4

"IDENTIFICATION OF DYES"

EXPENDITURE	£ s. d.	INCOME	£ s. d.
To STOCK 1ST JANUARY 1951	86 8 0	By SALES	99 6 2
" SUNDRY EXPENSES	4 8 1	" STOCK 31ST DECEMBER 1951	38 10 5
" SURPLUS TO ACCUMULATED FUNDS	47 0 6		
	£137 16 7		£137 16 7

"WOOL DYEING"

EXPENDITURE	£ s. d.	INCOME	£ s. d.
To PRINTING AND PUBLISHING	744 5 8	By SALES	192 2 0
" POSTAGES	9 15 4	" ADVERTISING	294 7 0
" ROYALTIES	24 11 6	" STOCK 31ST DECEMBER 1951	613 17 5
" SURPLUS TO ACCUMULATED FUNDS	277 15 11		
	£1,100 6 5		£1,100 6 5

REVIEW OF TEXTILE PROGRESS

EXPENDITURE	£ s. d.	INCOME	£ s. d.
To PRINTING AND PUBLISHING	– – –	By SALES	15 7 0
" POSTAGES	1 7 2½	" ESTIMATED AMOUNT DUE FROM THE TEXTILE INSTITUTE	25 7 0
" SURPLUS TO ACCUMULATED FUNDS	39 6 9½		
	£40 14 0		£40 14 0

"REPLIKA" COLOUR INDEX AND SUPPLEMENT

EXPENDITURE	£ s. d.	INCOME	£ s. d.
To STOCK AT 1ST JANUARY 1951		By SALES	
Index and Supplement	761 12 0	"Replika" *Colour Index* and Supplement	1,006 9 3
" PRINTING AND BINDING		" STOCK 31ST DECEMBER 1951	
Index and Supplement	168 0 9	"Replika" *Colour Index* and Supplement	307 17 9
" SUNDRY EXPENSES			
Index and Supplement	74 0 6		
" SURPLUS TO ACCUMULATED FUNDS	310 13 9		
	£1,314 7 0		£1,314 7 0

NEW COLOUR INDEX

EXPENDITURE	£ s. d.	£ s. d.	INCOME	£ s. d.
To EXPENSES			By BALANCE TO ACCUMULATED FUNDS	653 4 7½
Wages and National Insurance	210 1 2			
Printing, Stationery, and Postages	155 8 8½			
		365 9 10½		
" GENERAL EXPENSES				
Teas, Lunches, and Travelling	51 15 8			
Conference Expenses	124 0 10			
Telephone	39 17 8			
Electricity and Heating	10 17 1			
Sundries	9 7 3			
Rent, Rates, and Insurance	40 16 3	276 14 9		
" DEPRECIATION ON OFFICE FURNITURE		11 0 0		
		£653 4 7½		£653 4 7½

in addition to the normal business of running the Society, (*a*) the final details of the financing of the Second Edition of the *Colour Index*, (*b*) methods for meeting the increased charges for printing and publishing the *Journal*, and (*c*) the securing of new General Offices for the Society.

It became clear towards the end of the year that in 1952, owing to increases in costs of the *Journal* and general expenses of the Society, further income must be obtained if the financial position were to be maintained, and after the most careful consideration the Committee recommended to Council that the increased costs should be borne by members and purchasers of the *Journal*. An Extraordinary General Meeting of the Society, held on 1st November 1951, approved an amendment to the Bye-laws increasing the annual subscription for Ordinary Members from £2 2s 0d to £3 3s 0d and for Junior Members from 10s 6d to 15s 0d. Although the present Bye-laws enable Council to remit the membership subscription in whole or in part in cases of hardship, this whole question is under review. The price of the *Journal* to non-members has been raised from £3 to £4 per annum.

The increase in subscription is a matter of regret to Council, but no increase had been made since 1921, and this Society is probably the last of the publishing bodies to raise its subscription.

Council is grateful to the advertisers for their continued support of the *Journal*.

The Society was informed during the course of the year that the offices which it had occupied at 32–34 Piccadilly, Bradford, since 1931 would be required by the landlords when the lease expired at the end of 1951. The Society has been fortunate in securing alternative accommodation at 19 Piccadilly, and removal was effected in February 1952.

Bye-laws Committee—Early in the year, Council set up a small Committee, consisting of Mr. G. B. Angus, Mr. H. Foster, Mr. F. L. Goodall, and *ex-officio* members, whose object was "to co-ordinate the Bye-laws of the Society, to remove anomalies, and thus to render the Bye-laws mutually consistent". In the course of its work the Committee has made recommendations to Council on various points of principle and has incorporated amendments to the Bye-laws giving effect to the changes affecting the status of Vice-presidents approved at the Annual Meeting of Honorary Secretaries and Chairmen of Sections held in March 1951. The Committee has now reported to Council and incorporated all these amendments in a new draft set of Bye-laws, which Council will submit to the Annual General Meeting of the Society in March 1952.

Publications Committee—This Committee has continued to work hard during the year. The standard of lectures and communications published in the *Journal* has been maintained, but the total number of pages is now down to the 1939 level, in spite of the inclusion of the proceedings of the *Conference on the Tinctorial Arts To-day* in the December issue. However, lectures and communications now total 51 compared with 43 in 1939, and abstracts are now set in smaller type than in 1939. As a result of the great increase in the cost of production, the Committee has reviewed the format of the *Journal*, and has instituted changes, notably the omission of the names of individual authors from abstracts of patents taken out by firms, which will reduce the size of the Abstracts Section and especially the Index. The co-operation of authors of papers is sought in keeping their communications as concise as possible, but it is hoped that with the increased income the size of the *Journal* will be maintained and maybe increased, provided that matter of the required standard is forthcoming.

The Society is indebted to all who have contributed to the production of the *Journal*, particularly authors of papers, referees, abstractors, and Mr. C. O. Clark as editor of the abstracts of patents; also to Mrs. E. Thomson, who has undertaken the task of compiling the Index, so that it is expected that this will be published earlier than has been the case in recent years.

The third impression of the photolithographic reproduction of the *Colour Index* and Supplement, and the second impression of the second edition of *Identification of Dyes on Textile Fibres* by Ellis Clayton, have sold steadily during the year. A Spanish edition of Mr. Clayton's book, translated by Professor C. Mas Gibert and Señor J. Alsina Giralt, was published in Barcelona during the year. The second, revised edition of *The Theory and Practice of Wool Dyeing* by C. L. Bird was published during the summer, and has had a ready sale.

Colour Index (Second Edition)—There have been no further changes in the personnel of the Editorial Panel, and members have had a very busy and eventful year. The normal editorial work has involved the handling of a very large amount of information from co-operating dyemakers. It had originally been planned that 30th June 1951 should be the closing date for receipt of information from co-operating dyemakers, but it was necessary to extend this to 31st December, and the bulk of the material has now been received. Dye manufacturers continue to take the keenest interest in the work, and they are doing everything possible to complete their contributions so as to ensure inclusion in the published work.

This year was noteworthy in that we were privileged to have with us for discussion on the *Colour Index* Mr. C. Norris Rabold, President of the A.A.T.C.C., Mr. L. S. Little, Chairman of the A.A.T.C.C. General Research Committee, and Mr. W. D. Appel of the National Bureau of Standards, Washington, a past president of the A.A.T.C.C. Our joint discussions dealt with the cost of production, means of financing the work, and matters relating to editorial procedure. During the last few years book production costs have risen considerably owing to large increases in the price of paper and increased wages, and the effect of these increases has been that estimated production costs have risen by approximately 50%.

Approximate estimates indicate that the gross production cost will be of the order of £85,000, and it was agreed with our American colleagues that a ceiling cost of £90,000 should be set, and that if necessary economies would be effected to keep within this sum.

It is now possible to outline the form the new *Colour Index* will take. Part I will consist of three volumes, each of about 1000 pages, and will deal with approximately 5000 dye entities. The commercial names of each dye entity will be listed, with data on application, usage, and fastness properties. Part II will be a single volume of approximately 700 pages and will list the constitutions of 3500–4000 dyes. Part III will be a single volume of approximately 400 pages, containing a general index to Parts I and II, and is expected to list the 35,000 commercial names of dyes and also an index for intermediates.

The drawing up of the Agreement between the Association and the Society has been completed, and the formal signing took place on 18th January 1952. In agreement with our American colleagues a tentative production schedule has been drawn up on the basis that all data from dye manufacturers will have been received by the end of 1951. It is expected that the compilation of these data will be well advanced during 1952 and printing will occupy a further two years. It will be seen, therefore, that the tentative date for publication is 1955.

The present year will call for great efforts by the members of the Editorial Panel, and Council records its indebtedness to them for their past efforts and extends its good wishes for their future work. Council also wishes to thank those firms and institutions who have permitted and encouraged members of the Panel to take part in this work.

Society's Medals Adjudication Committee—On the recommendation of the Committee, Council has awarded the Gold Medal to Mr. W. Kilby, and extends its warmest congratulations to him. The citation in respect of the Medal appears in the January 1952 issue of the *Journal*, p. 4. In connection with the award of the Perkin Medal for 1950, Professor J. B. Speakman gave in Bradford on 1st November 1951 a lecture on "The Structure and Reactivity of Keratin", which was a review of the implications of recent work in this field, and was appreciated by a large gathering, the President being in the chair.

Worshipful Company of Dyers Research Medal—Council thanks the Adjudication Committee for its work in reviewing papers published in the *Journal* from July 1950 to June 1951, as a result of which the Court of the Worshipful Company of Dyers has approved the Committee's recommendation that the Company's Gold Medal be awarded to Mr. J. Crank for his work on the theory of dyeing (the citation in respect of the medal appears in the January 1952 issue, p. 5).

Presidential Badge—The Presidential Badge was presented to the Society at its Annual Dinner in March 1951 by Dr. C. J. T. Cronshaw in his capacity of Prime Warden of the Worshipful Company of Dyers. The design, by Mr. J. Chirnside, symbolises both the traditional craft and the modern scientific aspects of dyeing, and the Badge itself was exhibited by the Goldsmiths Company in connection with the Festival of Britain, as an example of modern British jewellery. The Council is extremely grateful for this further evidence of the interest taken by the Company in the welfare of this Society. A coloured illustration of the Badge was published in the June 1951 issue of the *Journal*, and the Society is indebted to Messrs. Imperial Chemical Industries Ltd. for defraying the cost of the colour blocks.

Worshipful Company of Feltmakers Research Medal—Council and the Adjudication Committee again have to report with regret the absence of any award of the Medal, but are glad to note that papers in this field are beginning to appear.

George Douglas Lecture—Owing to unforeseen difficulties it was not possible to hold the second George Douglas Lecture during 1951, but arrangements have now been completed for Dr. R. Hill to lecture on "Synthetic Fibres in Prospect and Retrospect" in Manchester on Friday, 7th March 1952.

Mercer Lecture—The eighth Mercer Lecture, on "Some Trials by Ingenious Inquisitive Persons—Regenerated Protein Fibres", was delivered by Dr. David Traill in Glasgow on 20th April 1951, the chair being taken by the President. The lecture hall was crowded, and the lecture itself was reported in the Scottish national press. The lecture was subsequently published in the July issue of the *Journal*, and constitutes a very useful review of regenerated protein fibres.

Arrangements have been made to hold the ninth Mercer Lecture in Leicester on Friday, 9th May 1952, when Dr. F. C. Wood will lecture on "Non-felting Wool and Wool Mixtures". The Mercer Lecture Committee has prepared a provisional programme of lectures for the next few years.

Annual Dinner—The sixty-seventh Annual Dinner was held at the Grand Hotel, Leicester, on 30th March 1951. The principal guests were Dr. C. J. T. Cronshaw, Prime Warden of the Worshipful Company of Dyers and an Honorary Member of the Society, and the Lord Mayor of Leicester. The Honorary Membership of the Society was conferred on Mr. G. E. Holden, C.B.E., unfortunately in his absence owing to illness, and the Perkin Medal was presented to Professor J. B. Speakman.

Conference on "*The Tinctorial Arts To-day*"—This Conference was held at Harrogate during September. Although some difficulty was at first experienced in obtaining practical papers, the Conference proved to be highly successful, and the fifteen papers, which had been circulated as preprints, and will shortly be available as a bound volume, gave rise to very interesting discussions. The attendance at the meetings was approximately 150–200 including fifteen overseas visitors. The

social programme included a civic reception in the Lounge Hall and the Society's Conference dinner and dance at the Grand Hotel, which was attended by over 330 persons. A programme of excursions to places of interest in the neighbourhood of Harrogate was greatly appreciated by the ladies. The Society is greatly indebted to the Harrogate municipal authorities for their very great help in making detailed arrangements and providing accommodation for the meetings.

FASTNESS TESTS CO-ORDINATING COMMITTEE—The Committee held eight meetings during the year, and the technical subcommittees, including the newly formed Hypochlorite Bleaching Subcommittee, are active. A Continental meeting organised by the French, Swiss, and German fastness committees, held at Basle in February 1951, was attended by Dr. P. W. Cunliffe, Chairman of the Fastness Tests Co-ordinating Committee, who was accompanied by Mr. G. B. Angus, a member of the F.T.C.C., and Mr. H. Blackshaw, who was present to deal with any matters affecting the Second Edition of the *Colour Index*. Dr. Cunliffe stressed the Society's desire for close collaboration with the Continental committees and also the necessity of working under the ægis of the International Standards Organisation. Subsequently members of the F.T.C.C. took an active part in the I.S.O. meeting at Bournemouth in June 1951, an account of which appeared in the August 1951 issue of the *Journal* (p. 307). Since then the Committee has been in constant communication with the fastness tests committees of the Continental group and of the A.A.T.C.C. The Committee feels that definite progress has been made towards the adoption of international fastness tests. Work on the preparation of an internationally accepted grey scale for fastness assessment has been vigorously undertaken.

The possibility of modifying slightly the light fastness standards B.S.1006: Part 2 with a view to improving their spacing has been under consideration, and a revised version of B.S.1006: Part 1 has been issued as a draft standard. Four publications sponsored by the F.T.C.C., mostly giving the history of the Society's work on fastness testing, have been published in the *Journal*.

The Council is grateful to Mr. K. McLaren for undertaking the work of Honorary Secretary of the Fastness Tests Co-ordinating Committee from July 1951.

DYEING AFFINITY OF REGENERATED CELLULOSE—The Committee has met during the year, and comparative dyeings are now being carried out by different members.

PRESERVATION OF HISTORICAL RECORDS—Several gifts have been received during the year. A very successful exhibition of historical records was held in conjunction with the "Tinctorial Arts To-day" Conference in Harrogate during September.

TERMS AND DEFINITIONS COMMITTEE—The Committee has decided on several tentative definitions, and has nearly completed its review of the extremely difficult question of colour terminology. Criticisms of tentative definitions already published have been received and will be considered collectively approximately six months after original publication. During the year Mr. H. C. Olpin took over the duties of Honorary Secretary of this Committee, and Council is very grateful to him for his continued interest in this work.

MOTH AND DERMESTID BEETLE PROOFING COMMITTEE—The members of the larval test subcommittee have been very active throughout the year and a tentative specification for a larval test method was completed at the beginning of the year.

The Committee was invited to be represented at a meeting called by the International Wool Textile Organisation held in Paris during April 1951 for the purpose of considering mothproofing test methods. The delegates included representatives from Holland, Switzerland, and the United Kingdom, the U.K. delegate being Mr. J. Barritt, who was accompanied as observers by Dr. Parkin and Mr. P. T. Gale, both members of the larval test subcommittee.

A cordial exchange of views took place, and since the Swiss approach, as illustrated by the E.M.P.A. specification, differed in general principle from that put forward by the Committee, it was agreed to carry out interlaboratory work on various proofed materials. The results of this work were completed towards the end of the year and discussed at a meeting in January 1952.

SOCIETY OF DYERS AND COLOURISTS OF AUSTRALIA—Council again extends cordial greetings to the S.D.C. of Australia and takes pleasure in its continued prosperity.

REPRESENTATIVES ON EXTERNAL BODIES—The thanks of Council are extended to members who represent the Society on the external bodies listed on p. 255 of the July 1951 issue of the *Journal*.

Council again wishes to express its appreciation of the services of Mr. R. Conchar of Messrs. John Conchar & Co., Honorary Solicitors to the Society, who has always been ready to deal with the legal matters which have arisen and during the year has been especially occupied in the drafting of the Agreement on the Second Edition of the *Colour Index* with the A.A.T.C.C. Council welcomes Mr. L. E. Jones, the new Honorary Patent Agent, and thanks Mr. J. V. Armstrong, who has undertaken this work for the Society in the past.

Council records its appreciation of the various donations which have been received during the year.

It is not possible in this report to mention all the activities of the Society, a more complete view of which may be obtained from a perusal of the *Journal*.

Council wishes to express its appreciation of all those members who give so generously of their time and energy in the service of the Society.

Finally, Council wishes to record its appreciation of the salaried officers and members of the office staff, who have given of their best during a busy year.

The Honorary Secretary (Mr. J. BARRITT), in moving the adoption of the Annual Report, which had been in members' hands during the past month, reported that the number of resignations which could be traced to the increased rates of subscription was small.

Mr. Barritt took the opportunity of conveying to the meeting best wishes from Mr. G. E. Holden, C.B.E., a past president of the Society.

Work on the Second Edition of the *Colour Index* was at the "end of the beginning", and we could look forward to publication in 1955. Both the supply and the price of paper in this country presented great difficulties, but the A.A.T.C.C. had been extremely helpful in finding a supply in the U.S.A. at a reasonable price (approx. 70 tons at £140 per ton). Both the Board of Trade and the Ministry of Materials had been most co-operative, and within the past few days the necessary import licence had been granted. No net transfer of funds from this country would be involved, as the cost of the paper would be set off against the costs of production in Great Britain. The Finance Committee hoped to put forward later in the year concrete proposals for financing the production of the Second Edition of the *Colour Index*.

The steady hard work of all committees was an indication of the goodwill which existed between the Society, its members, and the organisations to which they belonged, and this goodwill was undoubtedly the Society's greatest asset.

The Society was much indebted to Mr. R. Conchar of Messrs. John Conchar & Co., Honorary Solicitors to the Society, who had been most helpful during the past year, especially in connection with the Second Edition of the *Colour Index*, the lease of the Society's new offices, and the new draft Bye-laws.

Finally, Mr. Barritt expressed his personal thanks to the President and members of Council for the kindness shown to him during the year, and also recorded the Society's appreciation of the services of the salaried and office staff, who had carried on the day-to-day business of the Society in spite of the difficulties occasioned by removal.

Mr. F. FARRINGTON seconded the motion, which was carried.

ANNUAL ACCOUNTS

The Honorary Treasurer (Mr. H. JENNISON), in presenting the accounts for the year ended 31st December 1951, copies of which had been sent to members a month earlier, said that, even with the increased revenue from membership subscriptions, *Journal* subscriptions, and advertising, expenditure had increased to an even greater extent, resulting in a surplus of £1248 as against £2650 for the previous year. The greatest item in the increased expenditure was occasioned by the increased costs of paper and printing the *Journal*. These had been operative only during the last five months of the year, but if they had been in effect during the whole year our present surplus might well have been reduced to about £200. Further increases in costs were to be expected during 1952, and in addition the new premises were at an increased rental and expenses of removal and alterations had been incurred. It was reassuring to note that the influx of new members had almost counterbalanced the comparatively few resignations caused by the increased membership subscription.

Mr. Jennison felt sure that, after placing the facts before members, Council would have their full support in its efforts, which ultimately should prove of great benefit, not only to members, but to the prestige of the Society as a whole. He had much pleasure in moving the adoption of the Statement of Accounts and Balance Sheet.

Mr. A. P. KERSHAW seconded the motion, which was carried.

ELECTION OF PRESIDENT

Mr. F. SCHOLEFIELD, in moving the election of Mr. H. H. Bowen as President, said that he was well known to all. Mr. Bowen had been indefatigable as Chairman of the Publications Committee and held an eminent position in the industry. His integrity of character and agreeableness of manner left no doubt of his success in the office.

Mr. H. À BRASSARD said that, in nearly forty years' acquaintance with Mr. Bowen, he knew of no one who had been able to quarrel with Mr. Bowen. It was a great honour to second his election as President.

The motion was carried with acclamation.

At this point Mr. BOWEN occupied the chair. He thanked members for the great honour bestowed upon him in electing him President of the Society. He was deeply moved by the kindness and encouragement of so many members, and by the kind expressions used by the Immediate Past President. He would do his best to carry out the duties of President with the dignity and efficiency shown by past presidents.

VOTE OF THANKS TO RETIRING PRESIDENT

Dr. C. M. WHITTAKER said that it was a pleasant duty to move a cordial vote of thanks to the retiring President, Mr. F. Scholefield. The office of President made increasing claims on the time of its occupants, and Mr. Scholefield had presided over the Society's functions with dignified graciousness, while unruly members of Council had been kept in order with a velvet glove. Dr. Whittaker hoped that Mr. Scholefield would look back with pleasure on the past two years.

Mr. F. SMITH, in seconding the vote of thanks, said that Mr. Scholefield had been a wise choice, and it had been a pleasure to serve under him on Council. He regretted the loss of Mr. Scholefield as President, but hoped that the Society would see a great deal of him in the future.

The motion was carried with acclamation.

Mr. SCHOLEFIELD, in reply, said that any success he had achieved had been due to the co-operation of the officers, Council, and members of the Society. He was very grateful for the cordial manner in which the vote of thanks had been moved and carried.

ELECTION OF VICE-PRESIDENTS AND ORDINARY MEMBERS OF COUNCIL

The Honorary Secretary stated that a total of 600 ballot papers had been received, of which only 14 had been spoilt, thus leaving 586 valid papers. 75 ballot papers had been received by air mail from overseas countries outside Europe. The following, in alphabetical order, had headed the poll—

VICE-PRESIDENTS— Mr. G. B. Angus, Mr. C. O. Clark, Mr. H. Foster, and Professor J. B. Speakman.

ORDINARY MEMBERS OF COUNCIL— Mr. J. Boulton, Mr. A. Breare, Dr. G. T. Douglas, and Mr. F. Jordinson.

The President then declared the above persons elected.

VOTE OF THANKS TO SCRUTINEERS

A hearty vote of thanks to the scrutineers (Mr. J. V. Summersgill and Mr. E. Stead) was proposed by Mr. G. B. ANGUS, seconded by Dr. G. T. DOUGLAS, and carried.

VOTE OF THANKS TO RETIRING VICE-PRESIDENTS AND ORDINARY MEMBERS OF COUNCIL

Mr. F. L. GOODALL, in proposing a vote of thanks to retiring Vice-presidents and Ordinary Members of Council (viz. *Vice-presidents*— Mr. A. W. Dudbridge, Mr. J. G. Evans, Mr. G. G. Hopkinson, and Mr. E. A. Swift; *Ordinary Members of Council* — Dr. T. A. Forster, Mr. B. Kramrisch, Mr. F. Smith, and Mr. G. S. J. White), said that they were well known to all and personal friends to many. It was a loss that they must withdraw from office, but in the long-term interests of the Society this ruling was beneficent, and he wished them a year of enjoyable retirement.

Dr. R. L. ELLIOTT seconded the motion, which was carried.

ELECTION OF HONORARY TREASURER

The President announced that, no other nomination having been received, Mr. H. Jennison was re-elected Honorary Treasurer.

ELECTION OF HONORARY SECRETARY

The President announced that, no other nomination having been received, Mr. J. Barritt was re-elected Honorary Secretary.

APPOINTMENT OF AUDITORS

Messrs. Rawlinson, Greaves & Mitchell were reappointed auditors to the Society on the motion of Mr. H. JENNISON, seconded by Dr. T. A. FORSTER.

ADOPTION OF NEW BYE-LAWS

The Honorary Secretary moved the adoption of a draft set of new Bye-laws, copies of which together with an explanatory note had been circulated to members a month earlier. In January 1951 Council had set up a committee, consisting of Messrs. G. B. Angus, H. Foster, and F. L. Goodall, together with the Honorary Treasurer and the Honorary Secretary, the purpose of which was "to co-ordinate the Bye-laws of the Society, to remove anomalies, and thus to render the Bye-laws mutually consistent". In its report the Committee had incorporated amendments to the Bye-laws giving effect to changes in the status of Vice-presidents recommended by the Annual Meeting of Chairmen and Honorary Secretaries of Sections held in Leicester on 31st March 1951. The new Bye-laws proposed by the Commitee had been considered and amended by Council, and were now presented by Council to the meeting. Mr. Barritt felt that Council's objects had been largely achieved in the new Bye-laws, and he hoped that, following the adoption of the new Bye-laws, the Society would then be in a position to divert its attention to other matters.

Mr. H. FOSTER, in seconding the motion, said that a long time had been spent in considering the Bye-laws. Even so, they might not be perfect, but he felt that a reasonable set had now been drafted.

Mr. H. A BRASSARD said that he had been delegated by the London Section to state that the Section was unanimously and vehemently opposed to the new Bye-laws. It was hopeless for any person not resident in the West Riding or Manchester areas to expect to be elected to office. The London Section proposed that a Vice-president should be nominated by each Section, as they alone could know whom they wished to honour. They could be relied upon to choose well.

The Honorary Secretary stated that at the meeting in Leicester the representative of the London Section had agreed to the proposed changes in the status of Vice-presidents. More recently the London Section had put forward alternative proposals, which had been carefully considered but not accepted by Council.

Mr. A BRASSARD expressed the view that a postal ballot of the members would be desirable on such an issue, but the Honorary Secretary said that the Bye-laws required the decision to be taken at the meeting.

After a considerable discussion, a vote being taken, the motion was carried by a very large majority.

The President said that the points raised in the discussion would be carefully considered by Council.

RATES OF ANNUAL SUBSCRIPTION

Mr. H. JENNISON moved that the rates of annual subscription to the Society in accordance with new Bye-law 41 be as follows—

(i) During the period of "full-time national service" the annual subscription to be waived entirely. Such members will be asked whether they wish to receive the *Journal*.

(ii) Ordinary Members between the ages of 21 and 25 years who are students, i.e. who are pursuing an accepted course, full or part-time, at a recognised technical college or university and vouched for by the head of their department or other responsible person— 15s. 0d.

(iii) Other Ordinary Members between the ages of 21 and 25 years— £2 2s. 0d.

(iv) Members having had forty years' continuous membership of the Society to be given the option of paying half the current annual subscription (vi) for Ordinary Members.

(v) Members having had fifty years' continuous membership of the Society—the annual subscription to be waived entirely.

(vi) All other Ordinary Members—£3 3s. 0d.

(vii) All other Junior Members—15s. 0d.

Mr. G. E. STYAN seconded the motion.

On the motion of Mr. W. PENN it was agreed that (i) be amended to give members the option of not paying any subscription during the period of full-time national service, the wording to be as follows—

(i) During the period of "full-time national service" members to be given the option of not paying any annual subscription; members who do not pay will be asked whether they wish to receive the *Journal*.

With the above amendment the motion was carried.

VOTE OF THANKS TO CHAIRMEN

On the motion of Mr. W. A. EDWARDS, seconded by Mr. J. BOULTON, a cordial vote of thanks was accorded to the President and the Immediate Past President for their efficient conduct of the business of the meeting.

Mr. BOWEN expressed his own and Mr. Scholefield's appreciation of the vote of thanks.

Annual Dinner

The Annual Dinner of the Society was held at the Queens Hotel, Leeds, on Friday evening, 28th March 1952, under the presidency of Mr. H. H. Bowen.

The principal guest was Mr. N. G. McCulloch (*Chairman of the British Cotton Industry Research Association* and *Chairman of the Colour Users' Association*). Among other guests were Mr. W. S. Leuchars (*Prime Warden of the Worshipful Company of Dyers*), Captain C. B. Tidd, R.N. (*Renter Warden of the Worshipful Company of Dyers*), Sir George W. Martin, K.B.E. (*Master of the Worshipful Company of Feltmakers*), Dr. C. J. T. Cronshaw (*Honorary Member*), Mr. G. H. Spencer (*President of the Textile Institute*), Mr. M. Carter (*President of the Bradford Engineering Society*), Mr. J. Davidson Pratt (*Director and Secretary of the Association of British Chemical Manufacturers*), Mr. G. L. E. Metz (*Board of Trade*), Mr. C. G. Hulse (*Secretary of the Dyestuffs Control, Board of Trade*), Dr. F. C. Toy (*Director of Research of the British Cotton Industry Research Association*), Dr. A. B. D. Cassie (*Director of Research of the Wool Industries Research Association*), Mr. J. Wilson (*Director of Research of the British Rayon Research Association*), Mr. L. E. Jones (*Honorary Patent Agent*), Mr. F. Scholefield (*Immediate Past President*), Mr. W. Kilby (*recipient of the Gold Medal of the Society*), Mr. G. S. J. White (*Vice-chairman of the Manchester Section*), Mr. R. D. Chorley, Mrs. J. Consitt, Mr. G. H. Binns, Mr. G. Brearley, Dr. T. A. Forster, Mr. F. L. Goodall, Mr. F. A. Helme, Mr. R. C. Mather, Mr. A. Morton, Dr. F. J. Siddle, and Dr. W. Stauffacher.

The following officers and other leading members of the Society were also present—Dr. C. M. Whittaker (*a past president*); Mr. G. B. Angus, Mr. C. O. Clark, Mr. W. A. Edwards, Mr. F. Farrington, Mr. H. Foster, Mr. J. M. Goodall, Mr. R. J. Hannay, Professor J. B. Speakman, and Dr. H. A. Thomas (*Vice-presidents*); Mr. J. Boulton, Professor W. Bradley, Mr. A. Breare, Dr. G. T. Douglas, Dr. R. L. Elliott, Mr. D. Hanson, Mr. A. Thomson, Mr. H. A. Turner, and Dr. T. Vickerstaff (*Ordinary Members of Council*); Mr. F. Atack, Mr. D. A. Derrett-Smith, Mr. A. P. Kershaw, Mr. S. L. Peel, Mr. J. Porter, Mr. R. L. Robinson, Mr. G. E. Styan, Mr. H. Turner, and Mr. G. F. Wood (*ex-officio Members of Council*); Mr. J. V. Summersgill (*Honorary Secretary of the Publications Committee*); Mr. H. Jennison (*Honorary Treasurer*); and Mr. J. Barritt (*Honorary Secretary*).

"THE SOCIETY OF DYERS AND COLOURISTS"

After the toast of "Her Majesty the Queen", that of "The Society of Dyers and Colourists" was proposed by—

Mr. N. G. MCCULLOCH (*Chairman of the Shirley Institute and of the Colour Users' Association*), who expressed appreciation of the services which Mr. H. H. Bowen had rendered to the Colour Users' Association; although his work did not appear before the public eye of the industry, it was nevertheless vital to its best interests.

Mr. McCulloch said that he would like to make the subject of his remarks "The Place of Science in our Industry", and hoped to be able to say something which would give impetus to old ideas and would provide direction for new ones.

When our Society commenced in 1884, probably few of the members were men of scientific attainments or qualifications. The dyer's art is an ancient one, surrounded from earliest times by mystery, and no doubt much of that atmosphere was present in the early days of the Society. But science has changed those conditions, and now many of the early mysteries have been transmuted to ordered knowledge, so that he who runs may read. With these scientific values there still goes the art of the colourist, as always a work of skill, imagination, and intuition.

From the days when our forbears found their bases of dyeing and colouring in mineral pigments, in natural woods and products, we have moved to a time when they are of interest only to the antiquary and historian. From the days of Perkin's Mauve, in the development of basic dyes, the introduction of direct dyes, the use of azo dyes, right on to the vat dyes with all their variety of shades and uses, we see the hand of the modern

scientist. If we are to make the right use of the products which come from industrial organic chemical research, we ourselves must have an understanding of scientific principles and knowledge, and exercise that ordered thinking which goes with the name of science.

Conditions have changed since the early days of the Society, and there are amongst us now men of scientific ability of no mean order. Further, whoever reads the *Journal* of our Society must be impressed by the high standard of scientific work which goes to the informing and advising of our members through its pages. The chemical, physical, mechanical, and mathematical sciences all contribute their quota, and I shall therefore claim that we are a scientific society, and that you, my fellow-members, are scientists.

The sciences which have influenced the nature of our task have been those described as the exact sciences. When we think of scientific research we see in our mind's eye men active in laboratories of universities or of industries, in studies of chemical, physical, and suchlike problems. It has been said that physics is concerned with the resemblances of things and chemistry with their differences. But whether the physicist is studying resemblances or the chemist differences, they have one feature in common— their work is accurate and careful, and devoted especially to exact measurements. Their use of such apparatus as chemical balances, thermometers, ammeters, and voltmeters, of such terms as "specific gravity", "specific heat", and "atomic weight", and of equations to describe chemical reactions carries the implication of mathematical treatment. Exact measurement is necessary for a clear understanding of new products, and the laws of chemistry and physics could not have been discovered without this mathematical approach.

It was the outstanding characteristic of Lavoisier's contribution to the scientific knowledge of his day to emphasise the importance of exact measurement, and the success of his own researches commended the thought to his fellow investigators. Dr. J. Bronowski, in a recent article, summarised the matter simply when he said— "There was a time when experimental science was the pursuit and manipulation of exact measurement, and mathematics served it as a kind of arithmetic". This is indeed the hallmark of the sciences which have done so much to alter the usages of our industry and left so deep a mark upon our civilisation. It is fundamentally important to them and to their pursuit that there should be this manipulation and acceptance of exact measurement. To the modern chemist or physicist any suggestion that he should depart from a rigorous obedience to this principle would seem to him the repudiation of a fundamental doctrine.

The great discoveries of science were in the exact sciences, and they still continue. These successes have had so tremendous an effect upon the habits and customs of men that they have brought into the forefront the question whether, if the same mental discipline and method of thinking were exercised in other fields, it would be possible to make equally outstanding discoveries. Was it a fact that the experimental method could be used only in laboratories and upon matters of inanimate nature, or was it possible to take the problems that beset men themselves, in their minds and circumstances, as subjects for study and investigation? This meant, of course, that the respect and obedience to exact mathematical concepts, which had formed so vital a part of scientific investigation, might have to be departed from. Clearly, if it were possible to show that scientific research was possible along those lines, new fields of investigation and research would be laid open. There would be uncharted lands, and time would bring its meed of new discoveries. It would also mean that we must not place too narrow an interpretation upon science nor restrict its activities within too narrow limits. We must be prepared to seek new definitions, perhaps, and to broaden our outlook.

If scientific research were to be given wider significance, we should endeavour to define the characteristics of scientific thinking and so help to realign our attitude to scientific research. What are the conditions that must be attached to an investigation if it is to be called scientific? What is the mental discipline that must be followed if success is to be assured as it has been in the past? What do the great scientists themselves say of their own practices and thoughts?

Thus Leonardo da Vinci said: "Science should be based on observation; it may properly use mathematics to discuss the observation, and ought preferably to end with a crucial experiment to test its final conclusions". He insisted that mathematical reasoning alone can give complete certainty in science, but, he said, "this is a counsel of perfection".

Francis Bacon thought that, by suitably designed experiments and appropriate reasoning, thinkers should concentrate on discovering the fundamental laws and structure of Nature.

Lavoisier in one of his writings said: "I have imposed upon myself the law of never advancing but from the known to the unknown; of deducing no consequence that is not immediately derived from experiment and observation". While a modern scientist, Professor C. H. Waddington, in his book, *The Scientific Attitude*, defines science by saying: "The true influence of science is an attitude of mind, a general method of thinking about and investigating problems".

Another modern scientist, Sir R. Watson Watt, describes science as "an intellectual structure which has been built out of alert and exact observation, of imaginative and subtle speculation, and of exquisitely and elegantly ingenious experiment, devised to test and correct the speculation".

In his book entitled *The Use of History*, Professor A. L. Rowse has an interesting chapter which deals with this question of what are the fundamentals of scientific thinking. Summing up, he says: "What is it that historians have in mind when they

claim or disclaim history as a science? I think they have at the back of their minds an idea of exactness, a dependable objectivity, a capacity for being systematised as knowledge, exact, rigorous, and systematic".

Can we take it, therefore, that the mathematics which seemed so essential to Leonardo da Vinci is but one of the facets of science, and that it must be joined with an attitude of mind at once exact, systematic, and subtle? We can also say that scientific research depends upon the basic principle that order is the first law of Nature, and that through it all there run principles of order and system. The purpose of scientific research is to discover what these principles are and what is the nature of the order that exists. It is the understanding of these principles which points out the path along which imagination and intuition can move with certainty. This constitutes the knowledge that Francis Bacon said to be power. Without that knowledge the tremendous changes that science has brought about could not have been achieved.

When the question of whether the methods of scientific thinking could be used in other fields was asked, it resulted in efforts being made over the last fifty years to apply these principles of scientific thinking to subjects other than those of the exact sciences. These efforts have resulted in great advances in knowledge on matters of great importance and complexity.

An illustration of this extension of the field of scientific enquiry is the science of anthropology, which has sifted information relating to social customs and habits. It has greatly increased our understanding of primitive societies.

Contributing to the work of anthropology has been the science of psychology. The work of Freud and his fellow investigators has thrown a flood of light upon the working of the human mind and illumined many of its dark recesses. It has exercised a tremendous influence upon social custom and modified some of our views upon the way of life. It has been of great value in the treatment of mental disease. Because these investigators have dealt in such insubstantial matters as dreams, where there is no possibility of exercising minute and meticulous control and employing units of measurement, are we then to say that their work was not scientific? They have exercised those principles of thought and experiment which have already been mentioned, and the results have shown the investigations to have been conducted with the thoroughness of scientific thinking. Because there has been a tremendous range of new knowledge uncovered, prejudices have been overcome, and psychology has gained acceptance as a science by using methods faithful to the accepted principles of scientific research.

The scientific investigation of education has included efforts to define and measure intelligence, and a study of the laws of learning and the mastery of memorising. The necessity has been recognised of relating the method and content of instruction to the needs, conditions, and mental background of the student. As a result of the study of education by these principles outstanding improvements have been made in the method of instruction.

But, you will ask, what has this to do with the Society of Dyers and Colourists? We are neither anthropologists, psychologists, nor pedagogues. That is true. But we practise in our work applied chemistry and physics. We have studied these sciences and are able to understand the methods of thinking which the scientist uses. We should be able, therefore, to appreciate that the scientific method is being applied to subjects other than chemistry, physics, and mechanics. This is a new direction for scientific work, which takes in its stride problems that bear on human conduct and actions. It is a modern trend which older scientists, trained to more exact definitions, too often fail to treat with the sympathy and understanding the results so far achieved deserve.

And there is one aspect of our work which calls for this scientific treatment but which, so far, has hardly been recognised either as a fit subject for, or even as standing in need of, such systematic treatment. I mean the art of Management. It is a subject of wide importance, for all industry has management as its basis.

What are some of the problems of management that are suitable for scientific examination? Take, for example, the question of organisation. We say: Such and such a man is a good organiser. He is a leader, can make sound judgments, and is able to carry the responsibility of making decisions. He understands the art of devolving his responsibility and naturally secures the loyalty of his subordinates. We say he is a shrewd man. Out of experience he has made observations from which he has deduced principles which he can apply in varying circumstances. From observations he has deduced principles, and that is the method of the scientist. Rarely, however, has he satisfied the other demand of making his observations exact and accurate. Intuition has played too large a part and reason too little. What of organisation at board level? What should be the function of a board? Is a seat on the board looked upon as a reward for good departmental management, or are other qualities called for? What should be the relations of the members of the board to each other, to the staff, and to the general body of workers? What of the team spirit and the relation between authority and co-operation? Do the requirements of the board demand special training, and how is it to be achieved?

One of the objects of industry is to produce the highest quality at the lowest cost. What do we mean by quality? To say fitness for purpose is only a partial answer. What does the ultimate consumer require? Here is a subject for what is called market research. How far is costing to be used for fixing price, and what constitutes cost? There are, for example, power, material, time, labour, cost of supervision, rents, rates, taxes, and the cost of capital. Each of these in turn must be subjected to analysis. Having completed our analysis, we have

to proceed to the next step of the scientist, the making of observations, the collecting of facts. Here comes in one of the injunctions of the scientific method which we have already noted, that of exactness and accuracy. I venture to think that this condition of the scientist is rarely followed in this connection. But if we can realise that the success of science has depended upon such methods, and if we are prepared to make a scientific approach we shall find that there are many facts which have gone unrecorded, or if recorded have been quite insufficient in regard to the accuracy of the records which have been made. Further, not only must observations be accurate, but they must be sufficient in number to allow general principles to be deduced, without the exceptional cases exercising an undue influence.

Having completed this difficult and even exacting task of exact measurement, we come to the question of trying to find some general principles. How far, for example, are the costs due to the demands of the nature of our processes? If chemical reactions are involved, time is required to complete them, and time, of course, is quite essential. How much time, then, is there that lies within our own power to change? Here we have two principles which can be evaluated. How much cost is inherent in our process and how much cost is available to us for experiment to effect change and reduction? Take the question of the use of capital. Those industries which, by the nature of their process, must be continuous have their machinery in use to its fullest possible extent; that is to say, they use their capital 100% of its time. What percentage of the possible time do *we* use our capital, what would be the cost of using it to a much greater extent, and what would be the benefits?

We have heard quite a lot recently of quick methods of bleaching and of dyeing. There is no doubt that these problems have been thrown up because the general subject of management has been subjected to the treatment which the scientist accords to his problems. What happens in scientific research is that the solution of one problem throws up new ones, and this exact approach to our problem of management will throw a new light upon our technical activities as well as upon our management activities.

One of the consequences of such an examination has been to emphasise the importance of the personal relations between management and worker. Studies in the science of education have thrown great light upon the relation which exists between the teacher and the taught. Indeed, that has been shown to be of vital importance in bringing about outstanding improvements in the method of instruction. In like manner the scientific investigations of the problems of management have thrown up the tremendous importance that has to be attached to the question of relations between management and worker. What is the function of leadership? How far must authority exert itself, and what is the place of reason in that relationship? In fact, it is being shown more and more that high regard must be accorded to the claims for recognition of human personality.

Francis Bacon was not himself a scientist, but he exercised a great influence in bringing about those methods of thought which we now call scientific, and which have led to results with which we are all familiar. He accused the learned men of his time of "accepting on authority sweeping general principles which had been reached by hasty and uncritical generalisation from a few rather superficial observations". He met with much opposition, but gradually his views prevailed. I believe that if his advice were taken to heart by those of us who are responsible for the conduct of industry, we also would find our feet set upon the path which will lead to greater success.

Francis Bacon laid down also the principle that thinking men should direct their attention to the discovery of fundamental laws. This, too, has become one of the accepted principles of scientific method. If I am right in thinking that management should be studied in the same manner as, say, education has been studied, and that there is a science of management, then we also ought to have thinking men who are concerned with this question of fundamental issues. This can be achieved only in the right atmosphere, which is to be found in our seats of learning—universities and colleges of technology. I am confident that what I say is right, and I believe that the leaders of our industry should come together and take such steps as will secure, in university and college of technology, facilities at the highest level for the study of the application of scientific thinking to problems of management.

I have brought this subject to you to-night because, as I said at the outset, you are a body of scientists, members of a scientific society practising applied science. Therefore I can put to you my proposition—that science is seeking and winning new frontiers and making new conquests in the world of knowledge. I say to you, scientists, that here is a challenge which you cannot refuse. It is a claim that science has overleaped the old boundaries, and in so doing is reaping the successes that exact science has already reaped. As a body having a large responsibility for the application of science, you cannot leave this thought alone. It makes a claim upon your attention and is entitled to your moral, intellectual, and financial support. The success of science, as we well know, cannot be achieved by wishful thinking nor by the efforts of even shrewd minds. We do not get results by methods of trial and error, but, as Bacon said, we must concentrate on discovering, by suitable experiment and appropriate reasoning, fundamental laws. That means fundamental research. We must have trained minds competent and capable of understanding such work, and teaching us, the practical people.

I close upon this note: that while we have recognised the need for scientists to devote themselves to thinking over the problems of our dyeing and colouring technique, we must bestir ourselves to secure equally able men devoting equal time to

the study of, and research in, the problems of management. Only by so doing shall we retain our place of pre-eminence in our department of the world of textiles.

Mr. H. H. Bowen (*President of the Society*) expressed his great pleasure at responding to the toast. The Society was greatly honoured in having as chief guest Mr. McCulloch, a man of many parts — manufacturer, printer, dyer, and merchant— and deputy chairman of an organisation not only having considerable interests in this country, but also controlling numerous undertakings abroad, in the development of which he had played no mean part. Mr. McCulloch and his colleagues must be very proud of the C.P.A. research department, and particularly of the work carried out in its laboratories by Mr. J. R. Whinfield and Mr. J. T. Dickson, wonderful work, over quite a period, which had resulted in the discovery of Terylene, an outstanding achievement. Mr. McCulloch was also Chairman of the Shirley Institute and Chairman of the Colour Users Association.

Mr. Bowen said he was deeply grateful for the great honour of being elected President, and must express his gratitude to his firm for their kindness, consideration, and the facilities given to him in his desire to serve the Society. The greater part of his working life had been served under the leadership of that distinguished President and Founder Member of the Society, Mr. George Douglas, and he was proud to be thought worthy of filling the place the latter had once occupied. When the position had been offered to him, he had doubted whether he could fill such an important position adequately, but our amiable and ever helpful Honorary Secretary had finally dispelled his doubts. He would do his best to advance the interests of the Society, and he had full confidence that the Honorary Officers and Staff would give him unstinted help.

That night was, of course, the crowning night of the many happy times he had spent in the service of the Society on one or other of its numerous committees. These committees had to do a great deal of work, which could be done only because everyone was so helpful and friendly. The Society was more than fortunate in that it had so many members willing and anxious to help in its varied activities. These members gave of their time and labours freely; moreover, the Society was fortunate that so many firms— dyemakers and users— as well as research associations, universities, and technical colleges, realising the vital importance and necessity of the Society's work, allowed members of their staffs to serve upon these committees and to carry out the essential investigatory work in their laboratories and works. Look at the balance sheet, and you will find only small or no items of expenditure incurred in the vast amount of work carried out by these committees, but the real cost of the work of these committees is large. The services so willingly given by individuals and firms, not only in carrying out the work of the technical committees, but in publishing the *Journal*, in running the sections, and in the day-to-day operating of the Society, constitute a contribution of real value to the Society which never appears in the balance sheet. Without this voluntary contribution the Society could not live.

As Mr. Robert D. Chorley, of Messrs. Chorley & Pickersgill Ltd., was present that evening, he would like to mention that Chorley & Pickersgill had printed— and very beautifully printed— the *Journal* since January 1903, and thus at the end of the year would have carried out this very exacting task for fifty years, truly a great achievement. As President, Mr. Bowen expressed the Society's gratitude and sincere best wishes that the co-operation might continue for very many more years.

The *Journal* arrived at home or office only because of much planning and work done. The Society was greatly indebted to all who assisted in this work— the Publications Committee, authors, and abstractors. He had been for twenty-five years Chairman of the Publications Committee, years which he looked back on with pleasure and, yes, with pride: pleasure because the Committee was one of the most pleasant on which he had ever served; pride because during this time the *Journal* had been, as it still was, the foremost of its kind in the world, not only for the originality of its papers and lectures, but for its abstracts, which brought to members' notice the latest discoveries and advances. The provision of practical papers had always been a special care of the Publications Committee. The highlight had been the previous December's issue, which had contained the papers presented at the Harrogate Conference on "The Tinctorial Arts To-day". In itself, that issue provided a textbook such as could be written by no one man, and which, if it were published through the usual commercial channels, could not be sold for less than the annual subscription.

Referring to the financial position, our biggest cost was that of printing and publishing the *Journal*, and unfortunately this had risen steeply during the past financial year, because of the rises in the price of paper and printing. It might even rise still more, and it was this consideration that had led to the subscriptions being increased. The Council had been loath to recommend this increase, for it was proud of the fact that the subscription had remained unchanged for thirty years. It still was proud of that record, and of the fact that we were one of the last of the societies of equal status to raise its subscription.

The other aspect of the Society's finances to which he must refer was that of the Second Edition of the *Colour Index*. The outline of that project was now clear. At the commencement it had been decided that in it emphasis should be laid on the information required by the user of dyes. The provision of the vast amount of data thus necessitated, and the many new dyes that had appeared in the past quarter of a century, compelled the new *Colour Index* to be *much* larger than its predecessor. It would, in fact, consist of five volumes, three dealing with the individual dyes from the user's

viewpoint, i.e. dyeing and fastness properties, etc., one dealing with the chemical constitutions of the dyes, and one a general index. It was indeed a colossal work, which only the American Association of Textile Chemists and Colorists and ourselves could hope to undertake. Recent calculations indicated that the cost would be £85,000–90,000, to be shared equally between the A.A.T.C.C. and ourselves. The agreement for the joint production of this work had been completed a little time earlier.

The Council had been carefully husbanding its resources for some years, knowing that to finance this venture much money would be needed. The latest estimate had given the Finance Committee considerable cause for thought, for it was clear that, over and above the money at present available to the Society, another £20,000 would be required to meet its share of the costs. He knew that there were several gentlemen present that evening who not only knew full well the importance of this publication— which it was expected would appear in 1955— but who would not find much difficulty in helping us over that stile. However, despite the metaphor, we were not a "lame dog" but in truth a very virile one. There was little doubt that, accompanied by other honorary officials, he would shortly be seeking an audience not only with those who were present that night, but with others who were absent, and he knew he would not ask in vain. It had not been possible to obtain paper at a reasonable price in this country, and until a week or so earlier the position had been extremely difficult. However, thanks to the way the Board of Trade and the Ministry of Materials had appreciated our difficulties, it had now been possible to arrange for the whole of the paper required to be imported from the U.S.A. As all the printing was to be done in Leeds and Bradford, the new *Colour Index* would eventually be a dollar-earner.

The preparation of the new *Colour Index* was an example of co-operation with another scientific organisation, but it was not the only one, for we had co-operation with others— e.g. with the Textile Institute (whose President, Mr. George Spencer, we were glad to have as our guest), the Society of Leather Trades Chemists, and the Oil and Colour Chemists Association. With the growth of the Society's activities, we were bound more and more to work in co-operation with other scientific organisations, whose interests were linked with tinctorial technology. We were sincerely desirous of having even closer relations with them in working on problems of mutual interest, but we were equally desirous that there should be no sacrifice of identity or autonomy either by those with whom we co-operate or by this Society.

Our industry was now passing through a very difficult period of recession; clearly it was world-wide, and the situation was engaging the minds of all in the industry. The debate in the House of Commons that week would have made the whole country conscious of the difficult position. This country had been, and still was, noted for the high quality of its goods, and particularly its textile goods. It was Dr. Whittaker who had said that the task in front of the industry was to marry the speed of textile production as known in America with the world-renowned quality of British goods. High productivity had been achieved in this country, but it must go further. We must utilise the knowledge disseminated by this Society and other scientific societies, research organisations, etc. The time taken to introduce into practice new ideas must be cut down, and all— employer and employee— must be resolved to make more productive use of our existing resources of material, machines, labour, and power.

PRESENTATION OF THE SOCIETY'S GOLD MEDAL TO MR. W. KILBY

Mr. F. SCHOLEFIELD (*Immediate Past President*), in presenting Mr. Kilby, said that one of the most ingenious and impressive inventions of our times in the field of dyeing and finishing was that of

WILLIAM KILBY, B.Sc. Tech.

the Standfast molten-metal continuous dyeing machine. The larger share of the credit for this remarkable innovation was attributable to Mr. W. Kilby, and our Society was proud to take this opportunity of showing its sense of the value of his achievement.

Mr. W. KILBY expressed his deep consciousness of the honour conferred on him by the Society. The gesture was appreciated by other members of the staff of Messrs. Standfast Dyers & Printers Ltd., who as a team had contributed to the success of the development. He was especially pleased at the presence at the dinner of Commander R. S. E. Hannay, chairman of the firm and co-inventor of the process, whose great contribution had been both administrative and technical. In the early, more difficult days of their experiments, he had been thankful for the encouragement and advice of their late general manager, Mr. Robert Grundy, one of

the best of the old school of dyers, who had retained his interest in the process throughout a long and painful illness.

At Lancaster they had dyed more than twenty million yards by the molten-metal vat dyeing process. He believed that success had come only because they had been willing to analyse and learn from their failures.

"OUR GUESTS"

Mr. G. S. J. WHITE (*Vice-chairman of the Manchester Section*) said that for some years past he had attended these functions and listened earnestly to distinguished men proposing the toast of "Our Guests". Well turned phrases larded with anecdote and spiced with wit had hitherto been in keeping with the importance and dignity of that pleasant task. Now the duty devolved on him, and his prentice hand would scarce allow such full and sparkling treatment. Fortunately the occasion was made more easy as our guests were very well known to all present.

Firstly, it was due to the foresight, encouragement, and belief in research of the principal guest, Mr. N. G. McCulloch, that Terylene polyester fibre had been discovered. Devolving directly from that, Great Britain was represented among the leaders in the invention and technology of chemical fibres, giving pride of place only to the U.S.A. in this economically very significant field.

Secondly, those interested in academic affairs—and who connected with dye using and making could fail to be—would have seen in the *Manchester Guardian* the new plan for expanding the number of professorial chairs and for staffing the Manchester College of Technology. This was the outcome of vigorous and sustained attention—even pressure—by leading Manchester citizens, among whom Mr. McCulloch was a prime mover.

Next among the distinguished company of our guests were Mr. W. S. Leuchars, the Prime Warden, and Captain C. B. Tidd, R.N., the Renter Warden, of the Worshipful Company of Dyers. The Dyers Company had been in existence 571 years, and moreover was the thirteenth in the order of precedence of the London companies.

Of the twelve great companies which precede the Dyers Company, only two, or perhaps three—the Goldsmiths, the Clothworkers, and the Skinners—were *craft* guilds. The remaining nine, including the first four, were *merchant* guilds. It was apparent that for nearly 600 years the predecessors of our commercial colleagues had always usurped leading places, with the richest furs, the glossiest horses, the finest gems, and cloth of gold. We technologists had not caught up with them yet.

In the order of precedence, it was also notable that the Dyers Company followed the *Clothworkers*, which was vastly appropriate and might be expected. In its turn, it was followed by the Brewers Company, and who should say that that juxtaposition was without significance?

It was characteristic of many of our ancient institutions that they not only preserved the valuable practices of the past but also took a dynamic interest in the future. The Dyers Company fostered and supported research in the field of the tinctorial arts. It had also ennobled our Society and, at the same time, made a historic gesture when it presented us with our presidential badge. For these reasons we welcomed and were grateful to the Prime Warden and the Renter Warden.

The good fellowship and breadth of vision of Mr. G. H. Spencer, President of the Textile Institute, had promoted a most excellent relationship between the Institute and the Society. Those who had served with him and seen him in action dealing with foreign delegates to the Textile Institute conferences knew that we had an excellent ambassador for Great Britain, its textile industry, and its research. Especially well known was he to our sister society, the A.A.T.C.C., in the U.S.A., where both the Society and the Institute were held in the highest esteem.

The efforts of Mr. J. Davidson Pratt, Director and Secretary of the Association of British Chemical Manufacturers, to ensure that the industries we served had adequate representation in the appropriate Government departments must be apparent to all, and for that reason we were very glad to have his company. Mr. Davidson Pratt must be particularly mentioned for his success in organising those international conferences in recent years which had materially affected the progress of the chemical industry. We also welcomed Mrs. Joan Consitt of the A.B.C.M.

We must extend a hearty greeting to, and continuing thanks for the help we all received at the able hands of, Mr. G. L. E. Metz and Mr. C. G. Hulse of the Board of Trade.

The Board of Trade, as constituted in 1786, consisted of all the principal Officers of State, including the First Lord of the Admiralty and the Archbishop of Canterbury—the former presumably to cope when they were all at sea, and the latter to confirm some of their findings. In 1918 Lord Haldane's committee on the machinery of government described the Board of Trade as "The Department dealing with private enterprise as such". We who took pride in our private enterprise were fortunate in having to deal with such forward-looking and sympathetic members of this Government department as Mr. Metz and Mr. Hulse.

Adverting from the world of commercial endeavour, we would turn again for a moment to our recipient of the gold medal, Mr. W. Kilby. Not only was his invention a source of pride to himself and his colleagues, but his friends in and associated with the British dyeing industry were proud of a fellow craftsman who had successfully invaded "continuous processing", hitherto essentially a province of the Far Western world.

Distinguished members of research associations, led by Dr. F. C. Toy, Dr. A. B. D. Cassie, and Mr. J. Wilson, were welcome. The very practical researches they fostered would do much to extract

us from our present industrial difficulties, and by raising our efficiency would reinforce and reinvigorate us for further commercial enterprise. We also had the pleasant company of Mr. M. Carter and Mr. R. C. Mather, who represented engineering organisations well known for their skill and powerfully knit to progress in the textile industry. Science that night was well balanced by the humanities brought to our board by eminent pundits of the Press.

It was the particular character of the occasion that it attracted many members of the Society and their guests who did not normally concern themselves with the thermodynamics of dyeing or other similar oligotechnology. He was sure that it would be agreed that it was these guests and their hosts who gave our Annual Dinner its peculiar postprandial flavours. When the dinner was over, he would like to share their experiments in that field. He would therefore commend these particular guests most heartily.

Lastly, turning to Sir George W. Martin, K.B.E., his reputation and fame had spread far from that city of Leeds, of which he was such a very distinguished citizen.

Leeds had not the same intimate connection with dyeing that had Bradford or even Manchester. Its clothing industry had a long history dating from the congregation of clothworkers who met on Leeds Bridge by "Old Trash's" clock at 6 a.m. in summer and 7 a.m. in winter. This meeting expanded in the eighteenth century to form the cloth market.

Leeds had been a centre of the dyemaking industry *for many years* before Perkin made his historic discovery. A firm adherence to old-fashioned practices had allowed the initiative in dyemaking to slip into eager chemical hands up the valleys and over the Pennines. One particular example which illustrated local traditional conservatism coupled in more ways than one to forward-looking chemical research was the discovery and exploitation from 1887 onwards of the dyes made by diazotising aniline and coupling with fustic and vegetable extracts— queer anachronistic hermaphrodites whose use just survived to the present time in papermaking and leather dyeing. The Leeds dyemaking industry of today was characterised by vigour and progressive thought in all its departments.

Not only did Sir George represent this historic city, so closely linked with our Society through industry and University, but we welcomed him also as Master of the Worshipful Company of Feltmakers. The Company's support for research in the field of felt manufacture was cherished, and was a further example of the farsightedness of those who made research one of the traditions of the City Companies.

Ben Jonson says: "He that would have fine guests let him have a fine wife". We must be well married to our crafts so to entitle us to the fine guests we have here tonight.

Sir GEORGE W. MARTIN (*Master of the Worshipful Company of Feltmakers* and *Immediate Past President of the Leeds Chamber of Commerce*), in responding to the toast, congratulated the Society most sincerely on its prosperity. The Society showed good sense in having its *Journal* printed in Leeds. He felt a real affection for Lancashire, whence came the chief guest, and in fact the attendance of Lancastrians at the Lancashire–Yorkshire cricket matches helped to keep the Headingley ground solvent.

Sir George stressed the value of apprenticeship and pride in craftsmanship. He regretted the talk in the House of Commons of depression in the textile industry in Lancashire and Yorkshire. The industry had an umbrella and should use it. We were a great country, but we had had an easy time in industry for twelve years. Young people were unacquainted with the trials and hardships of pre-war years. But with hard work and endeavour we would surmount our difficulties; we must do our best in life and work.

Finally, Sir George thanked the Society on behalf of all the guests for its hospitality, and expressed the hope that all would go well with the Society in the future.

THE SECOND GEORGE DOUGLAS LECTURE

Synthetic Fibres in Prospect and Retrospect

ROWLAND HILL

Meeting held at the Midland Hotel, Manchester, on 7th March 1952, Mr. F. Scholefield (President of the Society) in the chair

INTRODUCTION

It is indeed a great privilege and distinction to have been asked to give this lecture to your Society. It is given in honour of George Douglas, a pioneer in the dyeing industry, a former Vice-president of your Society from 1894 to 1912, and President from 1912 to 1914. He would, one feels certain, have viewed the expanding prospect of synthetic fibres, which we now find before us, with relish and eagerness. His contributions to the textile industry were substantial, and are still with us.

Towards the end of the last century, the dyeing industry in Yorkshire and Lancashire was at a low ebb; vicious competition, uneconomic prices, and a general hand-to-mouth existence were the order of the day. There were too many small firms, mostly inadequately operated with insufficient work to keep them going. An exception to all this was the firm of Edward Ripley & Son, of Bradford, one of the oldest firms in the dyeing industry. Under the influence of George Douglas, Ripleys' had grown into a progressive and efficient organisation handling almost every kind of piece goods manufactured in the Bradford area, and in addition, certain kinds of Lancashire cotton goods. George Douglas was deeply concerned by the prevailing conditions which he found outside of his company. Inspired by the success in Birmingham of an Association of Bedstead Manufacturers, formed by amalgamation from a number of small firms, Douglas became convinced that a similar scheme could be applied with advantage to the dyeing trade. In this way, and through his organising ability, patience, and courage, the Bradford Dyers' Association was conceived and brought into being in 1898 "to effect the purchase of a number of businesses engaged in the Bradford Piece Dyeing Trade". Throughout the following years, Douglas applied his genius and energies to this great rationalisation; uneconomic works were closed, and others allotted to work for which they were best suited. As time went on, the obstacles were overcome, and the Association developed into that effective, efficient, and economically sound organisation that we know so well to-day.

At the inaugural lecture two years ago, that grand old man of the British dyestuffs industry, Dr. Herbert Levinstein, paid his own tribute to George Douglas drawn from close personal contact. During his address, Levinstein succeeded in bringing to life some of the leading personalities in those early days of the dyestuffs industry—Perkin, Caro, Peter Griess, Hofmann, and others. Here, indeed, was the foundation of industrial organic chemistry—the dyestuffs industry, an indispensable servant to the textile industry. It is, then, appropriate that I should be following in this second George Douglas Lecture with another offspring of industrial organic chemistry applied to the textile field—that of textile fibres themselves, produced by total chemical synthesis. It is appropriate too in that, since the early days of viscose rayon, Douglas had himself envisaged a great future for it. He became interested with Mr. Samuel Courtauld in the development of that great company, and later Mr. Courtauld paid a public tribute to George Douglas for his help.

RAYON

The rayon industry came earlier in this century with regenerated cellulose and later cellulose acetate. For many hundreds of years the natural fibres—cotton, wool, jute, and silk—had met the ever expanding requirements of service to the communities of the world; steadily mankind acquired the art of fashioning the natural fibres to wider and more exacting purposes. To-day, it is recognised only too well that the utilisation and performance of the natural fibres are limited by their chemical and physical properties. The treatment of cotton with urea–formaldehyde resins to improve crease-resistance, and the chlorination of wool to reduce its felting power, stand witness to this recognition. The rayons produced the first challenge to the natural fibres in the interval between the world wars, with, as we know only too well, a success which must have far exceeded the dreams of the most optimistic pioneers of that venture.

The initial emphasis with the rayons was in the direction of artificial silk, by which name they were known for many years, but it is doubtful whether in fact they ever did replace or even seriously threaten silk. Viscose rayon may have started under this guise, but to-day the staple form is cheaper than cotton, though this does not make it artificial cotton, or even a substitute for it. Much of the textile machinery is now working, it is true, with rayon staple; this is not because rayon has displaced cotton, but because it is a new material in its own right which gives new effects. There is always a temptation to think of new materials as replacing the old—of rayons as displacing natural fibres, and synthetic fibres as displacing natural fibres or perhaps rayons. This is illustrated in Fig. 1, in which the growth of the rayons is contrasted with the consumption of natural fibres in the U.S.A. over a period of years. It will be seen that consumption of cotton and wool have increased materially during the period when rayon was making its mark. It is vital to appreciate this, as we are now stepping over the threshold of the second major development of artificial textile

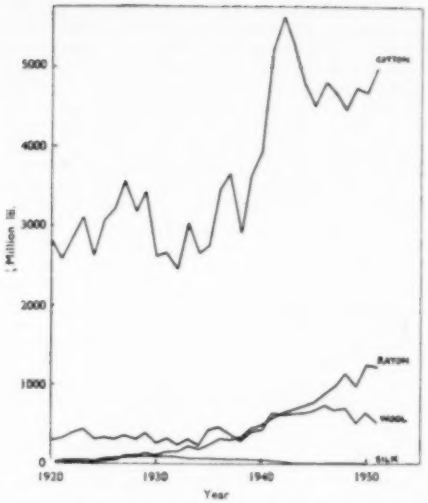


FIG. 1—Consumption of Fibres in the U.S.A.

fibres, the fully synthetic fibre built up from relatively simple organic intermediates.

SYNTHETIC FIBRES

It may help to gain the proper perspective by considering for a moment the very different subject of metallurgy. Here is the example of the commercial development over the past forty years of many metals which at the turn of the century were but academic curiosities. Aluminium, magnesium, and chromium are cases in point. These are now important— one might almost say essential— materials to our present way of life, though one would rightly add that this was not the case forty years ago. If it had been necessary to rely on the older materials of construction— iron, copper, lead, and zinc— then so many avenues of enterprise which could not have been foreseen at the time would have remained closed. Many will still ask the question: "Is nylon better than silk?"; but is this any more sensible than asking "Is aluminium better than iron or copper"? The answer is that structurally nylon is different from silk, just as aluminium is different from iron or copper, so that in some particular combination of properties, and for some particular purpose, each will stand out to advantage compared with the other. To carry the analogy a stage further, one may reflect on familiar alloys such as brass and duralumin, in which the alloys themselves are superior to their constituent metals in important respects such as hardness and strength. Just in the same way it is already beginning to appear that fibre blends will follow the same pattern, and show a performance, when appropriately mixed, superior in some desired respects to those of the constituents.

The progressive industrialisation of the world to-day calls for specialisation in fibres as it has done in metals and other materials. The future of synthetic fibres hinges upon this simple fact, and success will come to those fibres which show the greatest measure of useful distinctiveness at an economic level. Where natural fibres or the rayons are displaced by synthetic fibres, the displaced fibres then become available to meet the expanding demand of the increased population and the higher standards of living arising from the world's material progress.

In constructing new fibres from natural polymers, one is limited not only by matters of supply, but more important in some ways by what Nature provides by way of structure in such polymers. The structure of cellulose itself, and the necessity for preserving the essential structural features in any chemical treatment or modification, do impose serious chemical and physical limitations on what may usefully be achieved by the chemist. The issues are of a different kind with synthetic fibres. These are the problems of availability and potential cost of the desired chemical intermediates, a matter of industrial organic chemistry, of synthesising the desired polymer structure by a process free from disturbing side reactions, and of converting the polymer into a textile fibre, all of which demand an intimate appreciation of organic chemical manufacture, of high polymer chemistry, and of the broad requirements of the textile industry.

HISTORICAL

High polymer chemistry, now justly recognised as a science in its own right, has drawn its impetus largely from industrial developments of which the science of the new fibres themselves forms an integral part of the whole. Already in the early 30s vinyl chloride copolymers with a small amount of vinyl acetate designed to confer solubility in simple solvents were under commercial exploration in the U.S.A. under the name of Vinylite. Arising from this, it was logical that a new and intrinsically cheap polymer should be explored, and exploited if possible as a new material for textile fibres. This particular polymer had been devised in the beginning with solubility as a prime consideration, without any underlying thoughts as to its utilisation for new fibres. It was, therefore, only a question of converting the polymer into fibre form following the well known methods of solvent spinning already established for the rayons. Historically, Vinyon, as the fibre was known, was the first synthetic fibre to be produced commercially. It possessed some very serious limitations, particularly of low softening point and excessive shrinkage, which disqualified the fibre for most purposes, and it fell by the wayside. It was, perhaps, too much to hope that a polymer not specifically designed for fibre purposes could ever become a success. Nevertheless, in the light of this failure and with a clearer knowledge of the requirements, subsequent work pointed the way to producing higher-softening acetone-soluble copolymers of vinyl chloride with a minor amount (40%) of acrylonitrile, which are now attracting interest in the U.S.A. in the form of staple fibre under the name of dynel.

In Germany, too, polyvinyl chloride came under review at this time. The approach was different from that adopted in the U.S.A. Because of the restricted solubility in organic solvents, the polymer was chlorinated to impart solubility in cheap volatile solvents such as acetone, and was then produced in continuous filament and staple forms by a wet spinning process. Afterchlorinated polyvinyl chloride was used in Germany to a limited extent, under the designation of PeCe fibre, but like Vinyon, has some very distinct limitations.

This early history of synthetic fibres is, in retrospect, dominated by the figure of W. H. Carothers.

TABLE I

Different Types of Polycondensates (Carothers)

Type	Linking Group	Intermediates used in Preparation	Remarks
Ester	–CO·O–	Hydroxy acid Acid + glycol	Fibre-forming
Amide	–CO·NH–	Amino acid Acid + diamine	Fibre-forming
Thioamide	–CS·NH–	Aminonitrile + H_2S Diamine + dinitrile + H_2S	—
Urethan	–O·CO·NH–	Diisocyanate + glycol Dicarbamate + glycol	Fibre-forming
Thiourethan	–S·CS·NH–	Dithiocyanate + dithiol	Not fibre-forming
Urea	–NH·CO·NH–	Diisocyanate + diamine Diurea + diamine Urea + diamine	Fibre-forming
Thiourea	–NH·CS·NH–	Diamine + trithiocarbonate Diamine + NH_4CNS	Fibre-forming
Acetal	–C·O·CHR·O·C–	Glycol + acetal	Unstable, some fibre-forming
Thioether	–C·S·C–	Dithiol + dihalide	Fibre-forming
Sulphone	–C·SO_2·C–	Oxidation of thioether polymer	Fibre-forming
Anhydride	–CO·O·CO–	Acid + acetic anhydride	Unstable, fibre-forming
Ether	–C·O·C–	Chlorohydrin + alkali Glycol + dihalide	Low mol. wt.
Sulphonamide	–C·SO_2·NH–	Diamine + sulphonic acid or halide	Brittle fibres
Hydrocarbon	–C·C–	Dihalide + Na	—

Starting in 1928, Carothers' work centred around a fundamental study of the synthesis and structure of large molecules, mainly by methods involving polycondensation processes. At this time, ideas on high polymer structure were vague and ill formed, though the work of Staudinger, Meyer and Mark, and several others was gaining attention. It has been said subsequently that "Carothers and his colleagues were unaware, when they began their studies, that they would end up with a textile fibre at all". Indeed, it is correct to point out that Carothers' studies also led to the discovery of the synthetic rubber known as Neoprene, based upon 2-chlorobutadiene. Here, again, it could be said equally that there was no thought in the beginning that the work would lead to a synthetic rubber. There is a close interrelationship between fibres and rubbers, which may appear strange at first sight; this will be expanded later.

Nylon (polyhexamethylene-adipamide) was no chance discovery; pioneering research had been in progress systematically for eight years, before the key observation was made on 28th February 1935, and the first few grams of the polymer now known as nylon was produced on the test-tube scale. Prior to this, some hundreds of polymers had been made and rejected for one reason or another, notably low melting point, poor colour, thermal instability, hydrolytic instability, and absence of fibre-forming properties. In particular, the polyesters were examined closely as a class, but failed to attract interest because of low melting point and susceptibility to hydrolysis. It is relevant to record briefly (Table I) some of the types examined during this early period, which illustrates how wide the net was cast.

This period was invaluable: it provided a basis upon which a number of clarifying principles of high polymer chemistry and fibre formation were founded, notably that—

(1) The polymer should consist of very large molecules, of molecular weight not less than 12,000

(2) The polymer should be capable of crystallising, this property being possessed generally by linear polymers provided there are no side groups to destroy linear symmetry and close packing of the chains

(3) Three-dimensional polymers are unsuitable.

These principles, enunciated twenty years ago, still hold good to-day.

This early period was also valuable in a more practical sense in bringing to light some of the problems associated with the synthesis of high polycondensates, some favoured techniques, and the manner in which undesired side reactions frequently intrude. Carothers' career came to an untimely end in 1937, at a time when nylon was

in the transition from the test tube to the pilot plant. His had been an outstanding contribution not only in a material sense, but also because of its philosophical content, its pioneering nature, and its soundly constructed principles, upon which a new branch of science was to be based.

The early history of nylon was marked by the necessity of founding the commercial development on an entirely new method of spinning. Indeed this was fundamental to the success of the whole venture. Previously fibres had been produced commercially by spinning from solution, either by solvent evaporation as in the dry spinning of acetate rayon, or by coagulation in fibre form, as in the wet spinning of viscose rayon. The solubility of nylon was limited to phenol, cresols, and formic acid, none of which recommended itself as a basis for solvent spinning. The selection and development of melt spinning was something of a gamble in the beginning, but it has since paid off handsomely many times. Melt spinning is now firmly established; it possesses some significant advantages compared with the older methods, notably freedom from solvent and speed of spinning, together, perhaps, with greater potentialities for continued advance.

Motivated by the raw material position, patents, and timing, the development of polyamides in Germany took a different course. The main activity was concentrated on caprolactam polymer, known as Perlon L, and most of the polyamide fibres currently being manufactured or under development on the Continent are of this class. There are, however, differences between nylon and Perlon L which will be referred to later.

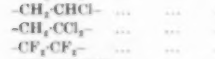
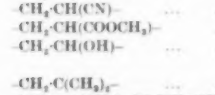
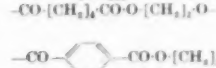
The discovery in 1941 of Terylene polyester fibre† by Whinfield and Dickson within twenty-five miles of Manchester is an interesting story, and illustrates how far intelligent thought, reading of the literature, and imagination may carry one. The earlier pioneering work of Carothers and his coworkers had led to the generalisation that polyesters were low melting. Whinfield argued that molecular symmetry should have a profound effect upon polymer- and fibre-forming properties, and it was arising from this thought that the isomeric benzenedicarboxylic acids were examined. These afforded the opportunity of producing polyesters in which the molecular symmetry was varied at will, and led to the observation that this is indeed an important factor affecting melting point, crystallinity, and fibre-forming properties. Following a systematic exploration of this thesis, polyethylene terephthalate (Terylene) was selected for commercial development.

Over the past three or four years, considerable interest has been displayed, particularly in the U.S.A., in fibres based exclusively or largely upon polyacrylonitrile. This polymer had been known for some years as an intractable and apparently insoluble material. Prior to the war, it had been reported as being soluble in hydrotropic solvents such as strong aqueous solutions of calcium thiocyanate. Subsequently, the picture changed when

† Terylene polyester fibre is a trade mark of Imperial Chemical Industries Ltd.

TABLE II

Requirements for Fibre-forming Polymers

Unit	Name	Softening Point (°C.)	Spatial Symmetry	Crystallinity	Chain Interaction	Orientability	Chain Stiffness
$-CH_2\cdot CH_2-$	Polyethylene	115	••	••	–	••	–
$-CH_2\cdot CHCl-$	PVC (Vinyon)	130	–	–	•	–	–
$-CH_2\cdot CCl_2-$	Saran	185	••	••	•	••	•
$-CF_2\cdot CF_2-$	Teflon (Fluon)	327	••	••	–	•	••
$-CH_2\cdot CH(CN)-$	Orlon	Decomp. 200	–	–	••	•	–
$-CH_2\cdot CH(COOCH_3)-$	Lactron	10	–	–	–	–	–
$-CH_2\cdot CH(OH)-$	Polyvinyl alcohol	Decomp. 150	–	•• Stretched	••	••	–
$-CH_2\cdot C(CH_3)_2-$	Poly*iso*butylene	0	••	••	–	••	–
$-NH\cdot CO\cdot[CH_2]_4\cdot CO\cdot NH\cdot[CH_2]_6-$	Nylon	265	••	••	••	••	–
$-CO\cdot[CH_2]_4\cdot CO\cdot O\cdot[CH_2]_2\cdot O-$	Polyethylene adipate	54	••	••	–	••	–
	Terylene	265	••	••	•	••	•
	Cellulose	Decomp. 180	••	•	••	•	••
—	Silk	Decomp. 160	–	••	••	••	–
	Rubber	25	•	•• Stretched	–	••	–
	Gutta percha	65	••	••	–	••	–

it was discovered that polyacrylonitrile could be dissolved in a limited range of rather unusual solvents such as dimethylformamide and butyrolactone, and that fibres could be wet or dry spun from such solutions. Orlon and Acrilan emerged in this way.

There are other synthetic fibres, too, which are either in an early stage of development, or are essentially speciality fibres with limited uses. These include the polyurethans (Perlon U) developed in Germany during the war years, an offshoot of the chemistry of *diiso*cyanates, polyvinylidene chloride in the U.S.A. (Saran, Velon), and polyvinyl alcohol in Japan.

In looking back over this brief historical review, it is seen that discovery and development of synthetic fibres have not followed a single simple pattern, but have proceeded along two broad highways. Firstly, we have polymer intermediates developed for non-fibre purposes being utilised for fibres, vinyl and vinylidene chlorides, originally produced commercially for plastics, and acrylonitrile for synthetic rubber, being appropriately polymerised to make them suitable for spinning operations, and for fibres. Secondly, there are chemical intermediates such as adipic acid, hexamethylenediamine, caprolactam, and terephthalic acid, substances which were formerly chemical curiosities being produced exclusively because they are seen to provide fibres of unusual distinction and merit.

RESEARCH

The underlying requirements for fibre-forming polymers are set down in Table II. Melting point, spatial symmetry, crystallinity and orientability, chain interaction and chain stiffness are all major contributory factors, determining whether the polymer is a fibre, rubber, or plastic.

It is now well established that the physical and chemical properties of a fibre depend partly upon the chemical structure of the linear polymer molecules, and partly upon the physical or architectural pattern upon which the fibre is constructed from the individual units. Chemical structure is, of course, determined by synthesis, and physical structure by the subsequent processes of drawing, annealing, and setting. Fibres are heterogeneous: they are built up from orderly regions or "crystallites", separated from one another by more disordered regions, frequently described as "amorphous". The transition between amorphous and crystalline regions is gradual and continuous.

TABLE III

Effect of Methyl Groups on Fibre-forming Properties of Polyamides and Polyesters

Repeating Unit	Crystallinity	Fibre Formation	M.p.* (°C.)
$-CO\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CO\cdot NH\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot NH-$	Yes	Yes	265
$-CO\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH(CH_3)\cdot CO\cdot NH\cdot CH_2\cdot CH_2\cdot CH(CH_3)\cdot CH_2\cdot CH_2\cdot CH_2\cdot NH-$	—	Yes	180
$-CO\cdot CH_2\cdot CH(CH_3)\cdot CH_2\cdot CH_2\cdot CO\cdot NH\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot NH-$	—	Yes	216
$-CO\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CO\cdot N(CH_3)\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot N(CH_3)-$	No (forms crystalline interpolymers)	No (interpolymers fibre-forming)	−75 (sets to brittle resin)
$-CO\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CO\cdot NH\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot N(CH_3)-$	Yes	—	145
$-CO\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CO\cdot O\cdot CH_2\cdot CH_2\cdot O-$	Yes	Yes	52–54
$-CO\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CO\cdot O\cdot CH(CH_3)\cdot CH_2\cdot O-$	Syrup thickening to rubber on increasing the molecular weight		
$-CO-C_6H_4-CO\cdot O\cdot CH_2\cdot CH_2\cdot O-$	Yes	Yes	265
$-CO-C_6H_4-CO\cdot O\cdot CH(CH_3)\cdot CH_2\cdot O-$	No	No	122
$-CO-C_6H_4-CO\cdot O\cdot CH_2\cdot CH_2\cdot CH_2\cdot O-$	Yes	Yes	221
$-CO-C_6H_4-CO\cdot O\cdot CH(CH_3)\cdot CH_2\cdot CH_2\cdot O-$	No (glassy)	No	80
$-CO-C_6H_4-CO\cdot O\cdot CH_2\cdot C(CH_3)_2\cdot CH_2\cdot O-$	Yes	Yes	140

* The figures given are all crystallite melting-points determined on the massive polymer.

Crystallites and chain segments in the inter-crystalline regions have preferred orientation along the fibre axis, imparted by drawing. From a textile aspect, many of the properties of fibres, such as stress–strain characteristics, dyeability, and moisture regain, may be related to the amorphous regions; the crystalline regions determine melting point, resistance to swelling, and the effects of other destructive agencies, for example bleach liquor.

Melting Point, Crystallinity, and Symmetry

In research directed towards constitutionally new fibres, the first aim must be to build up thermally stable structures which are crystalline and fibre forming, and have a sufficiently high, but not too high, melting point.

From the many hundreds of different kinds of polymers which have been made and studied reassuring principles are emerging. Melting point is, of course, a key property in determining usefulness of a fibre; we have recently gained a satisfying and rational picture (Fig. 2) of the effect of a structure upon melting point in a family of straight-chain polyhomologous fibres—polyesters, polyamides, polyurethans, and polyureas.

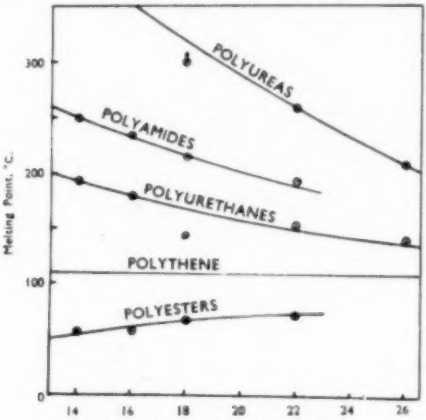


FIG. 2.—Melting Point Trends of Polymer Series

Comparable monomeric amides, ureas, esters, and alkylcarbamic acids form a melting point series in the same order as those of the polymers.

Hydrocarbon side chains reduce crystallinity (Table III); they probably act by increasing the separation of the chains and, particularly when unsymmetrically placed, by introducing linear and lateral disorder.

The ideas of Whinfield on the effects of symmetry which led to the discovery of Terylene have been amply confirmed (Table IV) by an extended examination of a variety of acids.

FIBRES AND RUBBERS

The technology and uses of fibres and rubbers are poles apart, and yet the fundamental underlying principles governing structure and properties are really very simply related. Natural rubber can be regarded as a fibre above its melting point. Fibre macromolecules are not as flexible as rubber, and hence are not so resilient at equivalent temperature increments above their respective melting points, and at equivalent molecular weights.

When rubber is stretched or a fibre is cold drawn, the principle is the same: the macromolecules are automatically oriented in the direction of stretch. An entropy factor favouring return to maximum randomness is thereby introduced. If the forces opposing retraction are greater, as in fibres, then the specimen will remain in the drawn form; but if the entropy factor exceeds that of interchain forces, as with rubber, the specimen will contract.

A particularly elegant demonstration of the relationship between fibres and rubbers is furnished by a progressive reduction in the interchain forces responsible for fibre properties in nylon. This may be accomplished by methylation or methoxymethylation of the hydrogen-bonding amide (peptide) grouping. The results of this are illustrated in Fig. 3.

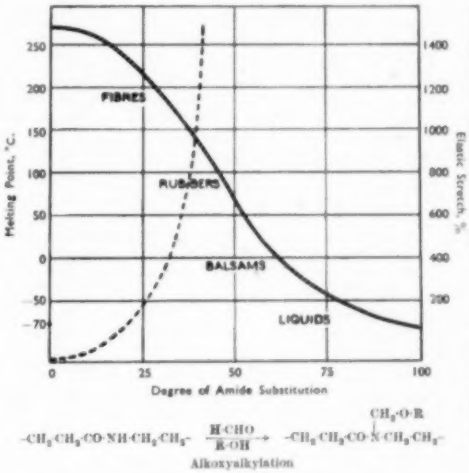


FIG. 3.—Hydrogen Bonding and Physical Characteristics

Melting point falls rapidly with increasing substitution, accompanied by reduction in modulus. There is a steady transition through the rubber-like state until finally, with complete substitution, the stage is arrived at where the polymer is a viscous liquid. This principle has been used experimentally in producing elastic nylon fibres. One is always impressed by these circumstances which demonstrate so elegantly the intimate and simple relationship between fibres and rubbers.

This also helps towards an understanding of the "rubber-like elasticity" or low modulus (of elasticity) of nylon compared with Terylene. It has become clear recently that the high melting point of Terylene arises from perfection in packing coupled with chain stiffness derived from the

TABLE IV

Effects of Symmetry—Ethylene Glycol Esters of Aromatic Dibasic Acids

Structure	Crystallinity	M.p.* (°C.)	Fibre-forming Properties
1:4	Highly crystalline	265	Excellent
1:3	Non-crystalline	102–107	Spinnable; some slight signs of cold drawing in high-molecular polymers
1:2	Non-crystalline	Low	None
	Highly crystalline	346	Spinnable with difficulty owing to high m.p.
Hexamethylene glycol ester of above acid	Highly crystalline	214	Good
	Glassy polymer	156	Poor, slight signs of drawability
	Glassy polymer	132	None observed
2:6	Highly crystalline	255–260	Good
1:5	Crystalline	226–230	Spins and cold draws
2:7	Not markedly crystalline	220	Spinnable; some indications of drawability
1:4	Non-crystalline	170	None observed

* The figures given are all crystallite melting-points determined on the massive polymer.

TABLE V

Termination of Chain Growth by Cyclisation in Polyamides

Component	End Group	
$H_2N{\cdot}CH_2{\cdot}CH_2{\cdot}NH_2$	$R{-}CH_2{-}CO{-}NH{\cdot}CH_2{\cdot}CH_2{\cdot}NH{-}R{-}CH_2{-}C$	
	Glyoxaline ring	
$HOOC{\cdot}CH_2{\cdot}CH_2{\cdot}COOH$	$R{-}CH_2{-}NH{-}CO{\cdot}CH_2{\cdot}CH_2{\cdot}CO{-}R{-}CH_2{-}N$	
	Succinimide ring	
$HO{\cdot}CH_2{\cdot}CH_2{\cdot}NH_2$	$R{-}CH_2{-}CO{-}O{\cdot}CH_2{\cdot}CH_2{\cdot}NH{-}R{-}CH_2{-}C$	
	Oxazoline ring	
$HOOC{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2{\cdot}COOH$	$R{-}CH_2{-}NH{-}CO{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2{\cdot}CO{-}R{-}CH_2{-}N$	
	Glutarimide ring	

p-phenylene segments in the chain. A practical consequence of this chain stiffness is the high modulus exhibited by Terylene.

Relaxing, Heat Treating, and Setting

Fibres are drawn in practice at very high speeds under tension. Not only does the fibre for reasons of entropy already discussed tend to return to its undrawn form, but there are additionally strains of one kind or another which are "frozen in". The effect of heating the drawn fibre can be twofold: firstly, the "frozen-in" strains are relieved, and secondly the crystallites are presented with an opportunity to grow, which they do. When a fibre has had its strains relieved in this way, it becomes dimensionally stable at all temperatures up to this point. This is important to both the fibre producer and the fabric finisher.

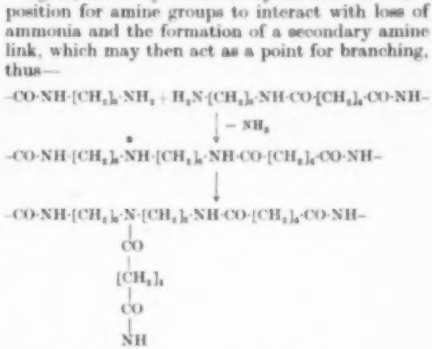
In the case of the lower-softening fibres it has become the practice to heat-treat or anneal the drawn fibres so as to push up the strain-release temperature as high as possible, and this is done by subjecting the fibre whilst still under tension, usually on a coned package, to appropriate heat treatment. The same principle is applied to fabrics or knitted goods in the finishing operation, when it is more customarily known as heat-setting. The permanence of such effects, as for example in the case of stockings, pleated dresses, and blouses, is establishing entirely new standards of performance.

To summarise, then, we are beginning to understand something about the relationship between polymer structure and primary properties such as melting point, crystallinity, and orientation, and this is about as far as prediction will safely carry one at present. It is as yet quite impossible to forecast in useful detail fibre properties from structure, and is likely to remain so for a long time to come.

Side Reactions

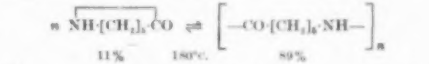
One problem concerning which we hear little, but which constantly harasses the polymer scientist engaged on the synthesis of new skeletal structures, is the intrusion of side reactions. In traditional organic chemistry, side reactions can usually be neglected, if indeed their presence is realised. The main product of a reaction is customarily purified, e.g. by distillation, crystallisation, or sublimation, and the product from the side reaction goes down the drain. Not so in high polymer chemistry, where the total product is more often than not the total make; the consequences of side reactions are embodied in polymer structure, and reflected in polymer properties. In building up high polymer structures, particularly with polycondensation reactions, the essential feature is a stepwise repetition of a reaction. Anything that interferes with this is reflected in the product. Stoichiometrically minor reactions can have a major effect upon fibre-forming properties; in the most general terms molecular weight is reduced (by loss of a reactive end group), or the structure is branched or cross-linked with serious consequences to thermoplasticity and solubility, i.e. spinnability. Some examples of chain termination, leading to limitation in molecular weight, which can occur in the synthesis of polyamides, are shown in Table V.

Again, in the synthesis of nylon there is a disposition for amine groups to interact with loss of ammonia and the formation of a secondary amine link, which may then act as a point for branching, thus—



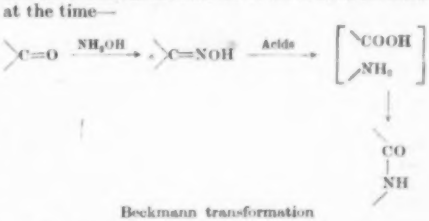
* Secondary amine linkage—point for branching.

A complication of a different kind may be illustrated by the case of caprolactam, used as the basis of Perlon L. Most polymers made by polycondensation have a monomer–polymer equilibrium practically completely on the polymer side. With caprolactam, however, the equilibrium, which is temperature dependent, is less favourable—



This constitutes a serious complication and a disadvantage compared with nylon, in which the equilibrium is almost entirely on the polymer side.

In passing it is worth noting that caprolactam is manufactured from *cyclo*hexanone oxime. This is the first large-scale exploitation of the Beckmann transformation of oximes into amino acids first described in 1886. It is indeed worth reflecting that sixty years had to pass before this academic observation was turned to practical account, and in a direction which could never have been foreseen at the time—



Beckmann transformation

These, then, are just a few examples from the many that could be quoted, which serve to show that very precise control in polymer-forming reactions is essential, if the undesirable effects of side reactions are to be minimised, and preferably avoided.

DEVELOPMENT

The magnitude of the commercial development of a fibre, such as nylon, or for that matter

Terylene, is perhaps not so fully recognised as it deserves. It is worth repeating that $6,000,000 was spent, and the services of 250 chemists and engineers were deployed, in the early phases on research and development on nylon in the U.S.A. A further $21,000,000 was spent before commercial sales were made. To-day we learn that du Pont have spent a total of $45,000,000 on research alone, and $196,800,000 on plant and facilities in the development of a single fibre, nylon. These are indeed staggering figures.

We have recently completed a plant at Billingham for making 5000 tons per annum of nylon polymer, and extensions are already under way to treble the capacity. This is certainly the most varied and complex organic chemical plant of its kind in Great Britain. A few facts and figures may not be out of place to illustrate the effort involved in translating the results of pilot manufacture and semitechnical-scale work to commercial practice. Thus, design effort alone necessitated 35 design engineers (as man-years) and more than 200 draughtsman man-years supported by necessary services. The number of final drawings was of the order of 3000, and the printing paper used for taking prints (29 in. wide) was approx. 20 miles in length, i.e. an area of 6 acres. Construction spread over 3 years required approx. 1400 man-years with a peak of 750 men. There are 7000 valves and 1600 major instruments in the plant, and the length of the "main-line" piping is roughly 150 miles.

The 5000 tons of polymer made annually at Billingham is fed into the spinning factory of British Nylon Spinners Ltd. at Pontypool to emerge for the textile trade mainly as continuous-filament nylon yarn, sufficient in length to encompass the earth 30,000 times. Imagine the problems connected with both the controlled extrusion of this length of yarn and then its submission to a very precisely controlled drawing operation, with the knowledge that slight underdrawing or overdrawing will bring defects of one kind or another. Nylon yarn is produced to a very exacting specification, and only attention to the finest points of detail makes this commercially feasible.

The new plant for making Terylene polyester fibre, upon which a start has been made at Wilton, will, it is estimated, cost in round figures £8,000,000. The fact that these enterprises are so complex, and yet new, has its impact upon the great variety of technical skills which need to be deployed. Organic and physical chemists, physicists, analysts, chemical engineers and engineers, textile scientists, statisticians, production experts, experts in specialised techniques such as X-ray, infra-red, and electron microscopy and mass spectroscopy, all play a very essential part. Let it be noted that research directed to new fibres costs little by comparison; though as each new fibre emerges, it becomes increasingly more difficult to find the new fibre which will have distinctive and valuable properties at an economic level. The method of establishing a substance as potentially useful in the complex field of fibres is slowly being charted, but is still inadequate and unreliable. As an American friend with much experience in this field so aptly observed: "Why, it costs $100,000 to take a peep through the keyhole". Thus, whilst discovery may result from the inspired work of several individuals, development and commercialisation demand the big battalions for efficient prosecution. It is not surprising in these circumstances that progress may appear slow to the casual observer and the uninformed.

SOME PROPERTIES

It would be a comparatively simple matter to catalogue a list of uses for which the various synthetic fibres are being promoted; this information is to be found in many textile journals. The question which should really interest us goes back to the earlier point that the successful synthetic fibres will be those that show a high order of distinctiveness and that reflect a favourable economic balance in performance.

Synthetic fibres as a class have at least two highly significant properties in common, which distinguish them from the natural fibres and rayon: these are low moisture absorption and high strength. The tendency in the world to-day is to minimise the chores of life by devices of all kinds, and synthetic fibres as a class fit into this pattern. The low moisture absorption of synthetic fibres is already being used in this sense, to make life less exacting. The Americans have aptly coined a phrase—"ease of care"—to signify this. Table VI

TABLE VI

Moisture Regain of Fibres

Fibre	Moisture Regain at 65% R.H.
Cotton	7·5
Wool	13·0
Silk	11·0
Viscose rayon ...	11·0
Acetate rayon ...	6·5
Nylon	4·5
Terylene	0·5
Orlon	1·0
Dynel	0·5

contrasts the moisture regain of the various fibres, and it will be noted that the synthetic fibres set up entirely new standards.

Low moisture uptake guarantees quick drying, but quite apart from the obvious direct advantages of this, the relative insensitivity of the fibres to moisture is reflected favourably in other respects. Thus, physical properties remain relatively unaffected by changes in humidity or actual immersion in water, and this assumes practical importance in many textile and industrial applications.

However, the very advantages that result from low moisture sensitivity bring problems in their train, the most obvious being dyeing, and to a less extent static. It is not surprising that this should be so. After all, the dyes and the dyeing and finishing industries have been tied from the beginning to the problems of dyeing the natural fibres. Progress had been made for the most part by research which aimed at discovering new dyes and thus expanding the range of colours and the

effects which could be produced. The advent of viscose rayon did little to disturb this situation. It is true that acetate rayon was to call for the special attention of the dye chemist, requiring the discovery of a new class of dyes, the so-called Dispersol and Duranol colours, but for the most part dyeing procedure itself remained unchanged.

New materials demand new techniques, and synthetic fibres are no exception. An interesting example is afforded by Orlon and dynel, where a complete departure from existing dyeing methods is noteworthy. It has been established that the introduction of cuprous ions into the dyebath greatly improves dyeability with acid, direct, and soluble acetate rayon dyes. It is believed that the metal forms a co-ordination complex between the pendant nitrile groupings of the polymer, reminiscent of the familiar phthalocyanine structure, and recalling, too, the rôle of chromium in wool dyeing, where similar interactions are believed to operate.

The synthetic fibres naturally differ amongst themselves in matters of degree; thus, because of the higher moisture regain, presence of basic end groups, and differences in internal order, nylon dyes more readily than Terylene, which in turn is superior to Orlon. The very fact that Terylene is more resistant to alkaline hydrolysis than would be expected from its chemical structure is a reflection of the low rate of diffusion, and this is the keynote of the dyeing problem—how to speed up the rate of dyeing. Dyeing at the boil or under slight pressures (20 lb./sq. in.), the pad–steam technique also under slight pressure, and the pad–dry heat process are all devices which should go a long way towards providing an acceptable practical solution. Then the observation that the rate of diffusion of dyes can be favourably influenced by the use of suitable dyeing assistants or carriers present in the dyebath is a notable contribution. There is here something of a challenge to ensure that all the technical effort and skill that are going into the research, development, and manufacture of these fibres are met in due proportion by the dyeing and finishing industry.

High strength, both wet and dry, is a second major contributory factor in many applications. It leads not only to higher standards of performance in applications where this is highly important, but it is capable of being used to create new standards and fashions, for example in respect of sheerness of fabrics. Another property which characterises synthetic fibres as a class is their inertness to chemical attack: thus nylon is characterised by alkali resistance; and Terylene, Orlon, and dynel by acid resistance. The strong point of nylon lies, as we all know, in its outstandingly good abrasion resistance. Orlon is distinguished on the other hand by superlative light and weather resistance; whilst Terylene has a very high measure of elastic recovery from low extensions. This means that in appropriate constructions, it can behave as if it were wool without some of the disadvantages of wool. Many unsuccessful attempts have been made to simulate wool-like elasticity in synthetic fibres by attempting to build up structures suggested by that of wool itself. The answer seems to be emerging from an entirely unsuspected direction, since the chemical structures of wool and Terylene are so dissimilar. This is one of the unexpected dividends which reward exploratory research from time to time, and make it so worth while.

THE FUTURE

We have already gone a long way since Carothers produced the first thread of nylon on that day in February 1935. The events of the intervening seventeen years have brought a growing consciousness and realisation within the chemical and textile industries of the future of the synthetic fibres. The reasons for this are not difficult to find.

The world production of textile fibres is currently in round figures 22,000 million lb. per annum, and over the past twelve years it has increased at the average rate of 300 million lb. per annum, including the war years. Of this total, the rayons are contributing a little short of 3000 million lb., about 14% of the total; and synthetic fibres, mostly nylon, about 200 million lb., i.e. 1% of the total textile fibre market on a tonnage basis, mainly concentrated at the moment in the U.S.A. The value of this 200 million lb. in yarn form is of the order of £120 million, at a very approximate investment cost of £75 million. This high investment charge, though perhaps not typical of all synthetic fibres, must obviously place a limit on the extent to which synthetic fibres can sensibly expand. Another key factor in the situation is a limitation imposed by the nature and amount of raw materials. At this stage, it is sheer speculation to attempt to forecast how far and how big synthetic fibres will grow. These facts give substance to the view already underlined that synthetic fibres will expand on the basis of worthwhile distinctiveness, and it is an economic appreciation of this distinctiveness that the chemical and textile industries are currently engaged in assessing.

Looking ahead, the polymer chemist will continue in his efforts to synthesise new skeletal structures, and produce from them fibres having this worthwhile distinctiveness. Whilst on the one hand there will be more signposts to guide in this search, it will nevertheless become increasingly difficult to find the new fibres of outstanding merit. The combined efforts of very many scientists have been spread across the past twenty-five years, and many thousands of different structures have been made and rejected for one reason or another. It is a sobering thought that, from all this intensive research, but five classes are currently being manufactured or are under advanced development, these being based upon—polyamides (nylon, Perlon L), polyesters (Terylene), polyacrylonitrile (Orlon, Acrilan), polyvinyl chloride, and polyvinylidene chloride. We shall undoubtedly witness minor modifications to these structures designed for specific purposes; but the birth of a structurally new fibre of merit and distinction is indeed a rare occasion.

So far, the main brunt of this venture has fallen to the lot of the chemical industry, but as supplies of fibres increase in amount and variety, the textile industry will be enabled to familiarise itself with

the new products, and to make its own contribution. As an essential aid to this, research in the future will increasingly be applied to the relationship between fibre and fabric form and textile properties. This will become a field in which the fibre manufacturer, the textile manufacturer, and the research associations meet with a common objective. The faster this knowledge can be built up, the greater will be the measure that these new materials are being used to maximum advantage. Our knowledge of intrinsic physical properties such as stress–strain characteristics and recovery is well established, and indeed formed the basis of the original selection of fibres for commercial development. But the factors affecting textile characteristics such as handle and drape, which are not wholly definable in terms of physical measurements, are still somewhat obscure, and it is in this direction that fresh knowledge will aid very materially.

The future of synthetic fibres will depend to a considerable degree upon the skill and ingenuity of textile manufacturers in designing and processing finished goods which best utilise their unique qualities. It is possible that this may require the development of new machines for spinning, weaving, dyeing, and finishing, so as to produce the best possible results with the utmost manufacturing efficiency. Then, again, admixture of synthetic with natural fibres provides the textile manufacturer with great opportunities to produce new effects, utilising and combining the best qualities of natural and synthetic fibres. Thus, the utilisation of polyamide and polyester fibres in combination with wool would appear to lead in the direction of mixed fibres having greater strength, improved wearing qualities, and comparative freedom from shrinkage, characteristic of the synthetic fibres, with the traditional "wooliness" and high comfort of wool. This field of mixed fibres, though obviously full of interest and promise, is still in its infancy, and lacking for the main part in the underlying textile science.

In conclusion, speaking for many colleagues and friends, let me say that there is everywhere the greatest enthusiasm for and confidence in the future of synthetic fibres; there is a vitality about it all, and a determination in so many minds to make it succeed. We have come a long way in the brief period since George Douglas made his own contribution to the textile industry. But the character and qualities which he showed through the years are just as necessary to-day. Alertness, patience, intellectual honesty, organising ability, good fellowship, and, above all, the respect and esteem of colleagues and associates were the qualities George Douglas displayed then, and equally command success to-day. So it is proper that the Society of Dyers and Colourists should from time to time honour one of the pioneers of the industry, for as a group they were men of quality, and George Douglas was notable among them.

Imperial Chemical Industries Ltd.
"Terylene" Council
Dyestuffs Division
Hexagon House
Manchester 9
Plastics Division
Welwyn Garden City
Herts.

COMMUNICATIONS

A New Method for the Dyeing of Mineral Khaki[1]

E. H. Daruwalla and G. M. Nabar

A new continuous single-bath process for the dyeing of mineral khaki on cellulosic textiles is described. The process consists in mixing the salts of chromium and iron with caustic soda in presence of an inhibiting agent such as glycerol to obtain a clear solution. The material is then impregnated with the clear solution, to which a coagulating agent which does not operate in the cold is added. The coagulation of the colloid, resulting in the precipitation of the hydroxides, is brought about by steaming the dried impregnated cloth. Dyeings having very satisfactory fastness properties are obtained.

Introduction

The production of mineral khaki on cellulosic textiles has received considerable attention during recent years. Although several modifications [2–8] of the original method generally attributed to Gatty [9] have been suggested from time to time, the essential procedure as technically carried out remains more or less the same. The greatest rival of mineral khaki at the present time is vat khaki. In America, khaki shades for military uniforms are mainly dyed using vat dyes. During World War II the demand for khaki-dyed cloth by the armed forces in India was very large, and in view of the high costs of dyeing with vat dyes, almost all of this cloth was dyed with mineral khaki. Much attention was paid to the various aspects of dyeing by this method, since the dyed cloth had to satisfy rigid standards for fastness to washing and perspiration.

In the normal khaki process the textile is impregnated with a mixture of aqueous solutions of chromium sulphate and ferrous sulphate, dried, and then passed through a boiling solution of a suitable alkali to precipitate the metals as hydroxides. The process is lengthy, and variations in the conditions of drying, developing, and subsequent airing have been found to have a profound effect upon the resultant shade and fastness properties. These difficulties can largely be overcome if the dyeing process is strictly controlled. It was considered desirable to see how far they could be minimised or overcome by the introduction of suitable changes in the chemistry of the dyeing process itself.

It is known that the presence of certain non-electrolytes, particularly those containing hydroxyl groups, e.g. cane sugar, glucose, glycerol, etc., can prevent the precipitation of the hydroxides of a

Printogen E

ensures clear prints

In the preparation of print pastes, PRINTOGEN E helps to produce homogeneous, smooth pastes which enable sharp and clear prints to be obtained. By its use the danger of streakiness and blotches is obviated and foam formation is suppressed.

PRINTOGEN E is emulsifiable in water, and printing preparations are easily removed from screens by cold hosing.

Sandoz PRODUCTS LTD. BRADFORD

SANDOZ

face centre

"It's those d.....* dyes !!!

why don't you use Dustless Serisols ?"

serisol DUSTLESS dyestuffs

Serisols for Acetate Rayon
Serinyls for Nylon

odh/254

First things first...
No use expecting level dyeing, clear colours or proper finishing without efficient chemical auxiliaries. We are specialists in this range, working to an exactitude which sets the standard for the whole Textile trade.
GCL
Textile Auxiliaries for Modern Dyeing and Finishing
PENTRONE (Fatty Alcohol Sulphonates). For scouring, cleansing, and penetrating all classes of textiles.
RESISTONE OP. (Synthetic Mordant). Unequalled for basic colours on all materials. Only one hour to mordant cotton—with no fixing bath.
RESISTONE KW. For Union Dyeing. Prevents cotton colours from staining wool. Essential for two-colour effects.
TEXOGENT. Powerful medium boiling-point solvent for Grease, Mineral Oil, Tar, etc. Saves soap in milling and scouring, ensuring more level dyeing subsequently.
TEXOGENT FA. A high boiling-point solvent for use in hot baths and acid liquors.
RANOTEX A & CW. For imparting soft handle to all classes of material.
TEXOWAX (Polyoxyethylene Glycols). Water soluble humectants, lubricants, plasticisers, etc.
GLOVERS
LTD
Wortley Low Mills, Leeds 12
Telephone Leeds 38037. Telegrams "Glovers, Wortley, Leeds."

If you use Azoics
you must try the newest

SOLUNAPTOLS
Trade Mark

The greatest recent advance in the Azoic Colour Process

After years of experiment a perfected material
has been produced by

JOHN W. LEITCH & CO LTD

the modern pioneers in British Azoics

Trade Mark
SOLUNAPTOLS

SOLUNAPTOLS

- Are clean, easily handled powders
- Dissolve readily in boiling water
- Need no additions to the bath
- Give well balanced *p*H conditions
- Give solutions with exceptional wetting-out power
- Give solutions which penetrate more perfectly
- Produce dyeings which are faster to rubbing
- Offer real advantages coupled with economy
- Offer a considerable saving to you
- Mean cleaner working and less worry

SOLUNAPTOLS

For samples, prices and demonstrations apply to
the Sole Manufacturers

JOHN W. LEITCH & CO LTD

MILNSBRIDGE CHEMICAL WORKS

HUDDERSFIELD

Telephone **Milnsbridge 189 & 190** *Telegrams* **LEITCH MILNSBRIDGE**

AGENTS *for*

INDIA
Khatau Valabhdas & Co
Vadgadi Bombay

SCOTLAND
Kirkpatrick & Lauder Ltd
180 Hope Street Glasgow C2

CANADA
Prescott & Co Regd
2309 Hingston Ave N D G Montreal 28 QUE

The effect of 'FIBROFIX' on washing fastness

Aftertreated with 'FIBROFIX' and copper acetate

Untreated
Both washed by the S.D.C. No. 1 washing test

'fibrofix'

THE fixing agent for direct dyes on all cellulosic materials

samples and information from sole selling agents in Great Britain and Eire

THE HEXORAN COMPANY LTD

manufacturers of chemical products

Unity Works, Belper, Derbyshire.
Telephone: Belper 471. Telegrams: Progress Belper

BEETLE IMPROVES . . .
COTTON AND RAYON. *Beetle* Crease-resistant and shrink-proof finishes.
WOOL. *Beetle* Shrink-Proofing and Anti-Felting.
LACE AND NET. *Beetle* Stabilisers (soft finish or crisp).
HEAVILY FILLED FABRICS. *Beetle* Water-resistant finishes for bookbinding cloths, window blinds, etc.
SHEEPSKIN. *Beetle* Resin treatment for converting into Beaver Lamb.
PIGMENT COLOURS, DELUSTRANTS, METALLIC POWDERS. *Beetle* Fixatives, by both printing and padding on most types of fabric (including delustrants for rayon, nylon and cotton).
MECHANICAL FINISHES. *Beetle* Textile Resins for glazing, embossing, etc. (recommended for "Everglaze" goods, produced in Great Britain under licence from Joseph Bancroft & Sons Company, Wilmington, Delaware, U.S.A.).
B·I·P GROUP

All Beetle finishes are colourless and wash-resistant

BEETLE TEXTILE RESINS

- can be applied on standard equipment
- can be mixed with each other to give two or more effects by a single process
- have ease of solubility and dilution in water
- do not discolour on application
- have long storage life
- are easily handled
- carry a full Technical Advisory Service from B.I.P.
- include both the urea-formaldehyde and melamine-formaldehyde types in varying degrees of condensation.

Booklet and Technical Leaflets from : **THE BEETLE PRODUCTS CO. LTD.**

74 CORPORATION ST., MANCHESTER 4. *Telephone :* Deansgate 4911. *Head Office :* 1 Argyll St., London, W.1.

"BEETLE" is a trade mark registered in Great Britain and in most countries of the world.

ALCOPOL O

DI-OCTYL ESTER OF SULPHO-SUCCINIC ACID

UNIVERSALLY ACKNOWLEDGED
THE MOST EFFICIENT WETTING
PRODUCT

ALLIED COLLOIDS (MANUFACTURING) CO LTD
BRADFORD MANCHESTER LONDON

JAMES ROBINSON & Co LTD

ANILINE DYE MANUFACTURERS HUDDERSFIELD ENGLAND

Telephone 334-335 Telegrams ROBINSON HUDDERSFIELD

AGENTS — SCOTLAND — Henderson Hogg & Co 17 Cadogan Street Glasgow C2 NORTHERN IRELAND AND EIRE — Mr F G Anderson 28 Exchange Street Belfast SWEDEN — A/B Nils Holmberg Halmstad 1 Sweden BELGIUM — Promatex Brussels AUSTRALIA — The Victorian Chemical Co Pty Ltd Melbourne EGYPT — Societe d'Avances Commerciales SAE Cairo DENMARK — The Stayers Co Copenhagen FRANCE — Seppic Paris SPAIN — Medeca Barcelona PORTUGAL — Weber & Co 82 Galeria da Paria 1 Oporto INDIA, PAKISTAN AND CHINA — D & J Fowler Ltd 86/88 Queen Victoria Street London EC4 NORWAY — Petter Endresen Postboks 352 Oslo FINLAND — A B Onarvo Oy Tampere

Welsh Guards Bandsman
Full Dress

Colour.... in industry

Quality and reliability in Dyestuffs are traditions at Clayton. In common with the British Army we combine the lessons of long experience with the discoveries of to-day, and provide for all colour users the comprehensive facilities of our Service Department.

Clayton

Aniline Company Limited
CLAYTON : MANCHESTER 11
Telephone East 1341 (10 lines)

SOLE CONCESSIONNAIRES IN THE UNITED KINGDOM FOR CIBA LIMITED BASLE SWITZERLAND

3 IMPORTANT *for increased*

TO CONTROL
FIBRE SLIPPAGE in WOOLLEN
and WORSTED SPINNING

Syton is an anti-slip agent for increasing fibre drag. Syton is recommended for use in woollen and worsted spinning. It imparts strength to the yarn resulting in fewer 'ends down' and, by permitting reduction in twist, gives increased production. Syton does not affect dyeing or finishing and scours out easily.

SYTON

The names 'Syton', 'Santobrite' and 'Santomerse' are Registered Trade Marks

For further details on the application of these three chemicals please write to Special Products Sales Department.

MONSANTO CHEMICALS LTD

CHEMICALS
production of textiles

MONSANTO'S PRESERVATIVE AGAINST MILDEW in TEXTILE SIZES and FINISHED FABRICS

SANTOBRITE *

Santobrite (sodium pentachlorophenate) is a preservative for preventing mildew and similar growths on sized yarns or finished fabrics. Especially suitable for cotton and linen. It enables larger batches of size to be mixed and kept, and allows sized yarns to be stored damp and pliable without risk of mildew or discolouration. Applied in the final wet finishing operation, it preserves fabrics in transit and in store.

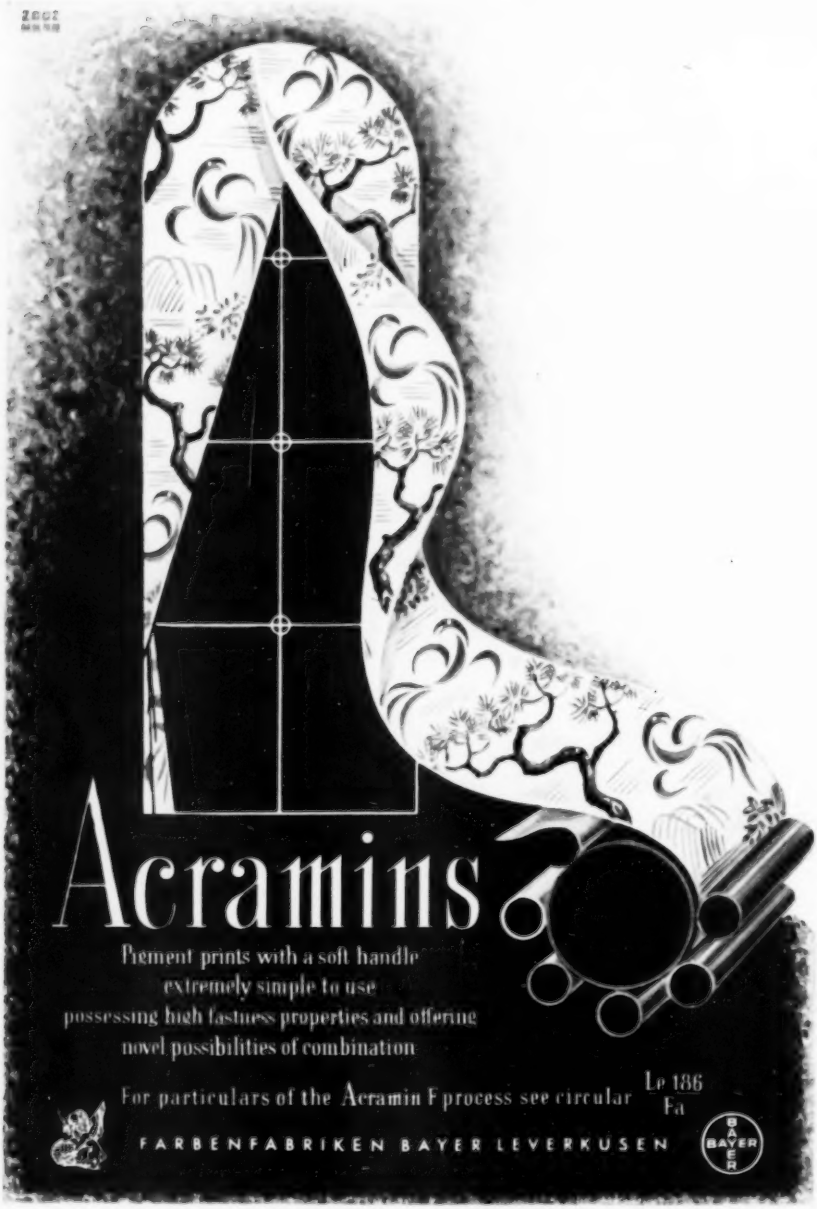
MONSANTO'S GENERAL PURPOSE DETERGENT for SCOURING and WASHING, for WETTING and LEVELLING

SANTOMERSE No.1 *

Santomerse No.1 is a general purpose synthetic detergent and wetting agent of the alkyl aryl sulphonate type. Santomerse No.1 is recommended for all scouring and washing processes. It is also invaluable as a wetting and levelling agent in dyeing. Santomerse No.1 is neutral, functions in hard water without leaving insoluble deposits and is suitable for use over a wide range of acid and alkaline conditions.

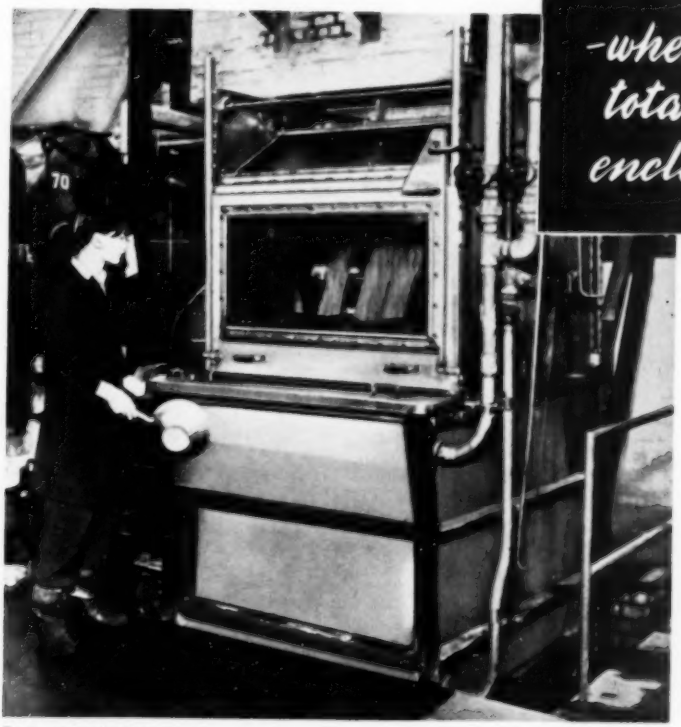
MONSANTO
CHEMICALS—PLASTICS

ALLINGTON HOUSE • LONDON • S.W.1


Acramins
Pigment prints with a soft handle
extremely simple to use
possessing high fastness properties and offering
novel possibilities of combination
For particulars of the Acramin F process see circular Le 186 Fa
FARBENFABRIKEN BAYER LEVERKUSEN
BAYER

ECONOMY in steam

-when its totally enclosed



Totally enclosed dyeing machine

Enclosed dyeing machines made of stainless steel effect a dual economy—they save steam, and thereby money, and also reduce delays and time spent in cleaning operations. With stainless steel it is possible to run a series of delicate tints through the same machine.

Metal Propellers Limited

Stainless Steel Specialists

74 PURLEY WAY, CROYDON, SURREY Telephone: Thornton Heath 3611

Telegrams: Metaprops, Souphone, London

CH.40

For wetting out
Neutral
Free rinsing
For all types of fabric
For high and low-temperature scouring
Unaffected by hard water
Reduces scouring costs
For emulsifying
LISSAPOL N
For detailed information please apply to
ICI
IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1

SODIUM HYDROSULPHITE

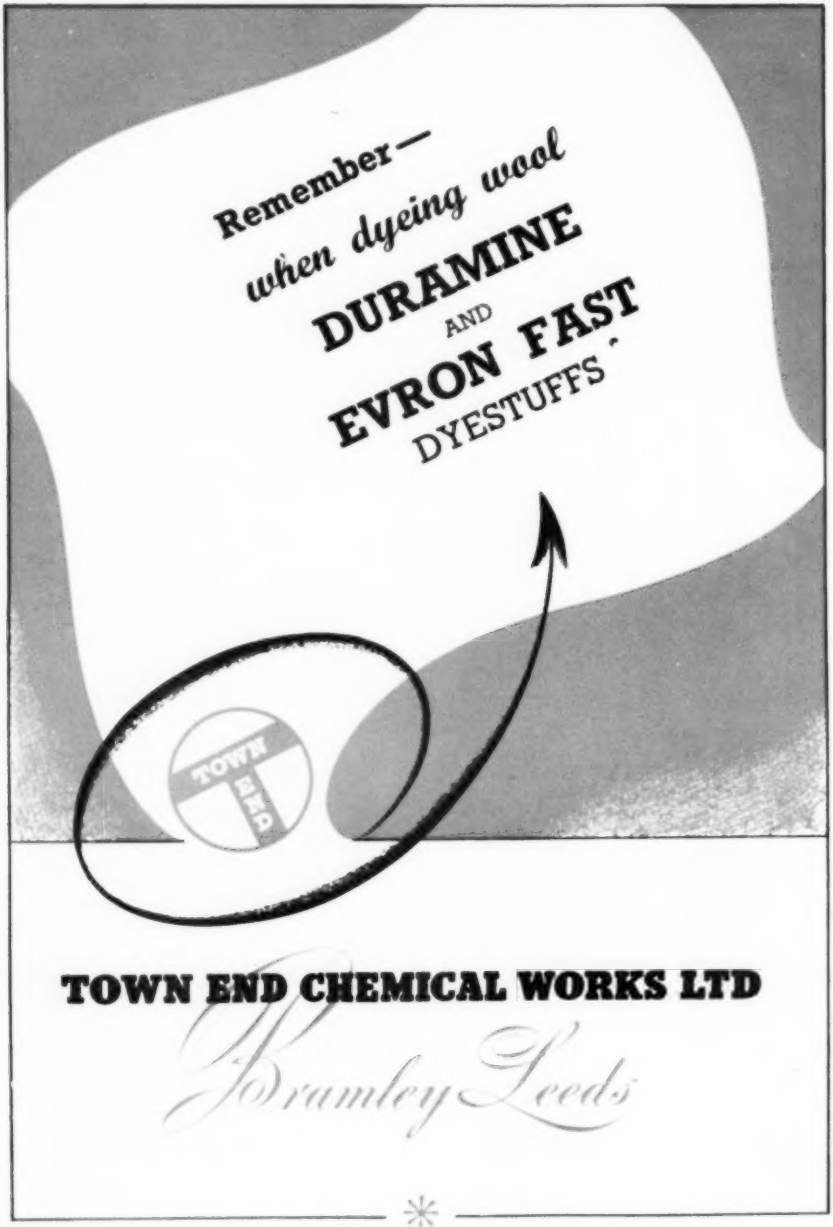
MANOX BRAND

HARDMAN & HOLDEN LIMITED

incorporating MANCHESTER OXIDE CO. LTD.

MANOX HOUSE · MILES PLATTING · MANCHESTER 10

TELEGRAMS "OXIDE," MANCHESTER TELEPHONE COLLYHURST 1551 (10 lines)


Remember—
when dyeing wool
DURAMINE
AND
EVRON FAST
DYESTUFFS
TOWN END
TOWN END CHEMICAL WORKS LTD
Wrambey Leeds

number of metals on the addition of caustic soda [10–15]. The solutions thus obtained remain clear and stable in presence of an excess of caustic soda. The precipitation of the hydroxides can later be effected at a controlled rate. It was thought that, if such colloidal solutions were used for impregnating textile materials and coagulated subsequently *in situ* under suitable conditions, a variety of khaki shades depending on the relative proportions of the two components in the mixed colloid should be obtained. This process, if it could be successfully developed, promised to avoid some of the disadvantages of the normal method, bringing about a substantial reduction in the time required. Preliminary experiments showed that this was possible, and after further trials khaki shades of excellent fastness to washing, perspiration, and rubbing were obtained. It was also possible to reproduce easily a dyeing of the required depth and tone.

In principle the process to be described differs from the normal process in that a solution containing salts of chromium and iron in the desired proportion is mixed with a solution of caustic soda in the presence of an agent to inhibit precipitation of the resultant hydroxides. The cloth is impregnated with the clear solution thus obtained, and after drying is steamed to precipitate the hydroxides in the body of the cloth.

Experimental Methods

MATERIALS

The chemicals, e.g. sodium dichromate, ferrous sulphate, ferric chloride, caustic soda, etc., used in experimental investigations were all of C.P. quality. In trials on the works scale commercial brands were used.

CLOTH

Grey cloth is desized and given a thorough boil in 3% caustic soda and 0·1% Igepon T (on weight of the material) to remove all natural and added impurities. The boiled cloth is soured and washed well with water. A portion of the boiled cloth is carefully bleached with sodium hypochlorite (2 g. available chlorine per litre) at pH 11, soured, washed, dried, and conditioned.

PREPARATION OF REDUCED CHROME LIQUOR

The reduced chrome liquor (10 gal.) is prepared as follows— 34 lb. commercial sodium dichromate is dissolved in 4·5 gal. of water, and 2·7 gal. of commercial sulphuric acid (164°Tw.) added. To this mixture a solution of 5·4 lb. of sugar in 0·5 gal. of water is added gradually. When the reduction is complete, the mixture is allowed to cool to room temperature, and the volume of the reduced chrome liquor is made up to 10 gal. The concentration of chromium in the reduced chrome liquor is estimated [16].

PREPARATION OF THE PADDING LIQUOR

The padding liquor (100 gal.) is prepared as follows— 45 gal. of reduced chrome liquor containing 56 g. of chromium per litre is mixed with 5 gal. of water and 66 lb. of ferrous sulphate crystals. After the ferrous sulphate has gone into solution, 10 gal. of glycerol is added, and after thorough mixing 30 gal. of 68% caustic soda. The mixture is allowed to stand overnight. 20 lb. of ammonium acetate is then added to the mixture, and after complete solution the liquor is ready for padding.

IMPREGNATION, DRYING, AND DEVELOPMENT OF THE DYEING

Impregnation is best done on a heavy three-bowl pad mangle. The cloth must be uniformly dry and absorptive. It is advantageous to give a passage through two padding mangles in succession. The padded cloth is dried in hot air at 75–80°c. This is followed by steaming in a rapid ager, and the pigments are uniformly deposited in the body of the cloth. The fabric is then given a rinse in cold water followed by a vigorous soaping at the boil with 0·5% soap and 0·2% soda ash, washed cold, and dried.

The success of the dyeing depends to a large extent on the rate of precipitation of the hydroxides. During the padding of the cloth, the colloidal equilibrium in the solution is not disturbed, but during the subsequent drying and steaming a progressive coagulation of the hydroxides occurs.

A large number of khaki shades are possible by variation in the concentration of the two components of the padding liquor. It is found that the shades produced as described above are greener than those obtained by the older process when the same proportions of iron and chromium are used.

In this manner a number of shades were produced under works conditions and their fastness properties were examined.

Experimental Results

INFLUENCE OF AGEING ON THE PROPERTIES OF COLLOIDAL SOLUTIONS AND THE RESULTANT DYEINGS

The colloidal solutions prepared from the individual solutions and from the mixture of the two were allowed to stand for a number of days and their stability was examined at intervals of 24 hr. All the solutions except those which contained ferrous sulphate alone showed good stability over a period of 96 hr. For those solutions which were stable, keeping for this length of time was found to cause no alteration in the resultant shade.

EFFECT OF DRYING UNDER DIFFERENT CONDITIONS

Since the rate and temperature of drying are known to influence the shades of normal mineral khaki dyeings, it was necessary to investigate the effects of these conditions on the properties of the dyeings produced by the new process. Portions of padded cloth were dried on drying cylinders (steam at 20 lb./sq. in.), in the hot-air stenter (75°c.), and in a hot flue (85°c.) respectively, and developed under identical conditions. The resultant shades were similar in depth and tone, but the material dried on cylinders showed the effect of creasing and that dried on the stenter developed clip marks. The fastness to washing and rubbing of the dyeings dried on the hot cylinders was satisfactory.

DETERMINATION OF FASTNESS

The main consumers of the khaki-dyed cloth are the armed forces, who lay down exacting specifications for the fastness tests. The dyed cloth was examined for its fastness to light, washing, rubbing, and perspiration.

FASTNESS TO LIGHT [17]— Fastness to light was determined by exposing a dyed sample to the arc of an Atlas Fadeometer. As expected the light fastness was of the highest grade, viz. 8.

FASTNESS TO WASHING, PERSPIRATION, AND RUBBING— The fastness to washing was determined by Test No. 4 recommended by the Fastness Tests Committee [18]. The fastness to alkaline and to acidic perspiration was also determined by the methods prescribed by the Committee. The results are summarised in Table I.

TABLE I

Cloth	Padding Liquor		Fastness to—		
	Iron (%)	Chromium (%)	Washing (Test No. 4)	Perspiration	Rubbing
Calico ...	—	1·904	3	3	3
Calico ...	1·904	—	3	3	3
Calico ...	1·0 (Fe^{III})	1·0	5	5	5
Calico ...	2·0 (Fe^{III})	2·0	5	5	5
Cotton gaberdine	1·326 (Fe^{III})	5·58	5	5	5
Bleached longcloth	1·326 (Fe^{III})	5·58	5	5	3
Short-staple cotton ...	1·326 (Fe^{III})	5·58	5	5	3

DETERMINATION OF BREAKING STRENGTH

Standard-sized samples were conditioned at $65 \pm 2\%$ R.H. and $82 \pm 2°$F. for 48 hr., and the breaking strength was determined on the Goodbrand breaking strength testing machine (Table II).

TABLE II

Breaking Strength of Dyed and Undyed Cloth

(Each value is a mean of 15 determinations)

Cloth	Breaking Strength (lb.)			
	Warp		Weft	
	Undyed	Dyed	Undyed	Dyed
(a) Bleached calico ...	223	346	129	198
(b) Bleached gaberdine	447	561	413	506
(c) Bleached calico from short-staple Indian cotton	198	209	37	64
*(c) after exposure for 2 months	148	180	32	58
(c) after exposure for 4 months	—	183	—	60
(c) after exposure for 6 months	74	181	23	59

* The samples were exposed continuously in the open from January to June 1949 in Bombay

The above results are striking in that the dyed cloth shows a different percentage increase in the strength after dyeing depending on the construction and other details. The increase in strength in the cloth made from short-staple Indian cotton is very small. The exposure trials show that the deposited oxides exercise a marked protective influence against the degrading action of light and air. After two months' exposure there appears to be practically no further change in the breaking load over a subsequent period of four months. With the undyed cloth a progressive fall in strength is observed.

ESTIMATION OF IRON AND CHROMIUM IN THE DYED SAMPLES

Dyed samples cut into small pieces of approximately uniform size are carefully incinerated in a platinum crucible at low temperature. The crucible is then transferred to a muffle furnace for one hour at 500–600°C. to obtain complete ashing. The iron and chromium contents of the ash are determined by the method used by Race, Rowe, and Speakman [19]. The results are given in Table III.

TABLE III

Padding Bath			Deposit on Cloth		
Cr (%)	Fe (%)	Cr / Fe	Cr (%)	Fe (%)	Cr / Fe
5·58	1·33	4·21	3·36	0·65	5·19
4·88	1·12	4·30	2·89	0·59	4·90
4·28	0·98	4·30	2·71	0·55	4·82
3·09	0·74	4·18	1·98	0·47	4·23
2·14	0·50	4·28	1·42	0·34	4·16

Analysis of the above results shows that the concentration of chromium deposited on the cloth bears a fairly constant ratio to the concentration of chromium in the padding liquor. In the case of iron, however, it is found that the relative amount of iron fixed on the cloth decreases as the concentration of iron in the bath increases. This is further shown by the increase in the ratio of chromium to iron on the cloth.

From the foregoing results it is seen that the mineral khaki dyeings produced by the new process compare very favourably with those obtained by older methods, and that the method possesses other advantages, particularly in the simplicity of operation and uniformity of the shades produced. The method, being a single-bath process, is found to give a greater output than older methods when carried out under comparable works conditions.

DEPARTMENT OF CHEMICAL TECHNOLOGY
UNIVERSITY OF BOMBAY
BOMBAY 19
INDIA

(*Received 15th December 1951*)

References

[1] Nabar and Daruwalla, *Indian P.* 37,446 (1947).
[2] Gatty, *BP* 6128 (1887).
[3] Galloids, *GP* 45,998 (1889).
[4] Hay and Moffat, *GP* 7919 (1893).
[5] Badische Anilin- und Soda-Fabrik, *GP* 112,611 (1898).
[6] Horrocks, *BP* 7888 (1899).
[7] Furth, J.S.D.C., **16**, 161 (1900).
[8] Sunderland and Bradford Dyers' Association Ltd., *BP* 19,205 (1905).
[9] Gatty, *BP* 11,456 (1884).
[10] Graham, *J. Amer. Chem. Soc.*, **15**, 253 (1862).
[11] Chatterji and Dhar, *Chem. News*, **121**, 253 (1920).
[12] Sen and Dhar, *Kolloid-Z.*, **33**, 193 (1923).
[13] Kuhn and Pirsch, *ibid.*, Special No., 310 (April 1925).
[14] Sen, *Quart. J. Indian Chem. Soc.*, **4**, 131 (1927).
[15] Nabar, Patel, and Desai, *Kolloid-Z.*, **57**, 173 (1931).
[16] Cumming and Kay, *A Text Book of Quantitative Chemical Analysis* (London: Oliver & Boyd 1919), p. 92.
[17] *B.S.* 1006:1942 (London: British Standards Institution).
[18] *First Report of the Fastness Tests Committee* (Bradford: the Society 1934).
[19] Race, Rowe, and Speakman, J.S.D.C., **57**, 213 (1941).

Quantitative Estimation of Eulan CN, Mitin FF, and Lanoc CN in Wool

R. S. Hartley, F. F. Elsworth, P. G. Midgley, and J. Barritt

Two methods are described for estimating Eulan CN, Mitin FF, and Lanoc CN in wool. Eulan CN and Lanoc CN form chloroform-soluble coloured complexes in the presence of copper sulphate and pyridine. The reaction is specific for these and other closely related chemical compounds, and may be used for their estimation. Mitin FF and also Eulan CN and Lanoc CN may be estimated by means of the chloroform-soluble complex formed in the presence of Methylene Blue. This reaction is non-specific.

(1) Introduction

The protection of wool and other keratinous materials against attack by the larvæ of the clothes moth, the carpet beetle, and other keratin-eating pests is now a process of commercial importance. A variety of mothproofing agents, differing widely in properties and method of application, are available, and an account of these has been given in an earlier publication [1].

For processes of this kind it is desirable that adequate methods of estimation should be available, both for the purpose of control during application and for assessing the fastness of the proofing to treatments, such as domestic washing and dry cleaning, which it may be required to withstand during the life of the material to which it has been applied.

In determining the mothproofing properties of any particular treated sample of wool material, factors other than the actual amount of mothproofing agent present, e.g. cloth and yarn structure, degree of soiling, may play an important part, and for this reason the ultimate assessment of mothproofing properties must be made by means of a larval test [1], which consists essentially in exposing the sample to attack by clothes moth or carpet beetle larvæ for a given period of time and assessing the degree of resistance either visually or by loss in weight. This method of test is unfortunately lengthy, at least two weeks being necessary to obtain a satisfactory result.

Hence the estimation by chemical means of the amount of the mothproofing agent present in the sample is of real value as a supplementary method, since it provides a quick and reasonably accurate guide to the degree of mothproofing of a particular sample when the result is considered in relation to predetermined threshold values for the particular mothproofing agent under consideration. By eliminating extensive larval testing, chemical methods also provide a convenient means for studying the performance of mothproofing agents.

Satisfactory methods for the estimation of certain mothproofing agents in commercial use, e.g. fluorides [2], pentachlorophenol [3], and DDT [4,5], are already available. Other mothproofing agents, viz. Eulan N, Lanoc CN, Eulan CN, and Mitin FF, the so-called "permanent" mothproofing agents since they confer mothproofing properties which possess a measure of fastness to washing as yet not attained by other types, are also in extensive commercial use. Methods for the estimation of Eulan N and CN have been briefly described by Clark [6], but no information as to the recoveries has been given. The methods depend upon the formation of a deep blue coloration when a solution of mothproofing agent in amyl acetate is shaken with aqueous ferric chloride. For estimating Eulan N, the wool is first dissolved in 140°Tw. sulphuric acid. Eulan CN is removed from the wool by extraction with alcoholic ammonia. Interference by dyes is claimed to be eliminated by reduction of the dye to a colourless compound with zinc dust in acid solution. Various difficulties resulting from the instability of the coloured complex have been experienced by the authors in using this method; e.g. the amyl acetate solution tends to be turbid, and usual methods for clearing the solution lead to appreciable colour loss; colour development is also sensitive to traces of residual acid. Another method, depending on the titration of the anion of the mothproofing agent with a large cation, has also been described [7], but such a method is obviously non-specific in that it does not distinguish between the two distinct chemical types represented by Eulan CN and Lanoc CN on the one hand and Mitin FF on the other.

Methods for the estimation of these latter agents have been developed in these laboratories and have proved of considerable value. One method is, as far as is known, almost specific for Lanoc CN and Eulan CN, which react identically, and it gives very good recovery of known amounts of these agents. The second method is non-specific in that it returns all three agents and also certain anionic synthetic detergents. However, when it can be shown, by means of a qualitative test based on the first method, that Lanoc CN and Eulan CN are absent, then the second method is a useful means of estimating Mitin FF, provided that it can be assumed that interfering substances of the anionic synthetic detergent type are absent. The recovery of known amounts of mothproofing agent is of a lower order than that obtained by the first method.

The methods have been extensively used in these laboratories almost entirely for research work, for which it is usually convenient to use undyed material. Because of this, little experience has been gained in carrying out determinations on dyed materials, and no attempt has been made to investigate systematically this application of the methods. It is known, however, that the presence of dyes will interfere with the estimation in many instances, but such interference should be capable of elimination. In spite of this obvious limitation to their general use, it is considered that publication of the methods will be useful to other workers, whose experience may lead to its being overcome.

(2) Preparation of Solution

The first stage in the estimation of mothproofing agents after application to wool is to

obtain a solution to which the analytical technique can be subsequently applied. Two methods have been used successfully with undyed wool—

(*a*) Extraction of the wool with aqueous pyridine at the boil, giving a solution containing the mothproofing agent together with other extractable substances but essentially free from protein.

(*b*) Digestion of the wool in 78% sulphuric acid at ca. 100°C., giving a solution containing both mothproofing agent and the products of keratin hydrolysis.

The pyridine extraction method may be followed by either of the analytical methods which are described, but the acid digestion method has been found applicable only to the Methylene Blue method.

2.1 EXTRACTION WITH PYRIDINE

The sample of wool containing up to 6 mg. of the mothproofing agent is sandwiched between two perforated glass plates about 1 in. in diameter and secured by tying with cotton thread. Alternatively, the sample may be placed in a Gooch crucible of suitable size. The sample and its container are then placed in the barrel of an all-glass extractor consisting of a 100-ml. flask to which the barrel, about 1½ in. in diameter, is attached by means of a ground joint. A water condenser is fitted above the barrel.

Pyridine (7 ml.) and water (5 ml.) are placed in the flask. On boiling the mixture, pyridine vapour passes up the barrel, condenses, drips on to the wool, and drains back to the flask. The pyridine in contact with the wool is maintained continuously boiling by vapour coming from the flask below. The extraction is continued for 10 min. After cooling, the extract together with washings from the flask is transferred to a separating funnel (copper–pyridine method), or to a 100-ml. graduated flask and made up to volume with distilled water (Methylene Blue method).

2.2 DIGESTION IN SULPHURIC ACID

To a sample of the wool, preferably containing up to 6 mg. Mitin FF or 1·2 mg. Lanoc CN or Eulan CN in a test tube, 78% sulphuric acid (sp. gr. 1·70) is added in the proportion of 8 ml. per gram of wool. The test tube is then immersed in boiling water for 20 min., after which the wool is completely dissolved. The digest, together with washings from the test tube, is transferred to a 100-ml. graduated flask, and made up to volume with distilled water.

(3) Copper–Pyridine Method

Eulan CN[8] has certain structural features, viz. free hydroxyl groups in chlorine-substituted benzene nuclei, similar to pentachlorophenol, which can be estimated[3] by means of the golden-brown complex which is formed in the chloroform layer when a chloroform solution containing it is shaken with a solution of copper sulphate in aqueous pyridine. It has been found that when an aqueous solution of Eulan CN containing copper sulphate and pyridine is shaken with chloroform a brownish-pink coloration develops in the chloroform layer. This coloured solution, which is almost completely formed in a single extraction, has been found to obey Beer's law over the range 0–6 mg. Eulan CN per 100 ml., and to be very suitable for the estimation of Eulan CN in pyridine extracts of wool. The spectrophotometric data on the colour

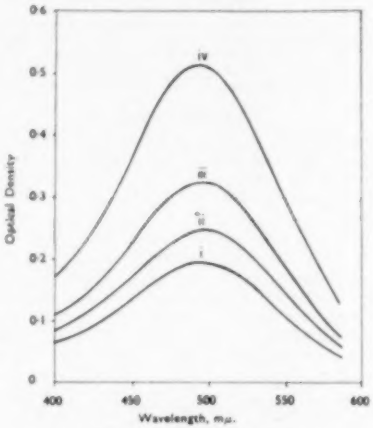


FIG. 1.—Absorption Curves of the Copper–Pyridine Complexes of Lanoc CN and Eulan CN in Chloroform

complex obtained using a Unicam spectrophotometer are shown in Fig. 1 and indicate that maximum absorption occurs at 495 mμ.; the data also indicate the very close similarity in behaviour between Eulan CN and Lanoc CN.

3.1 PROCEDURE

To the pyridine extract and washings in a 100-ml. separating funnel is added 5 ml. of 1% copper sulphate solution. The mixture is extracted successively with 20- and 10-ml. portions of chloroform (which must be pure and free from acid), these having been found to remove the coloured complex completely. The chloroform extracts are combined in a 50-ml. graduated flask, the volume is made up to 50 ml., and if necessary about 0·5 g. anhydrous sodium sulphate is added to remove any water present. The amount of mothproofing agent present is then determined either by colorimetric comparison of the coloured solution with solutions similarly prepared using known amounts of mothproofing agent or absorptiometrically.

3.2 STANDARDISATION

In these laboratories absorptiometric measurements on the coloured solutions have been made using a photoelectric absorptiometer[9] with 1-cm. cells and an Ilford Spectrum Blue–Green Filter No. 603. The results obtained using aliquots of aqueous solutions containing known amounts of air-dry Lanoc CN or Eulan CN* are illustrated in Fig. 2.

* The Lanoc CN used was the commercial product marketed by Imperial Chemical Industries Ltd. The Eulan CN was the commercial product marketed by I.G. Dyestuffs Ltd. and was obtained in 1939.

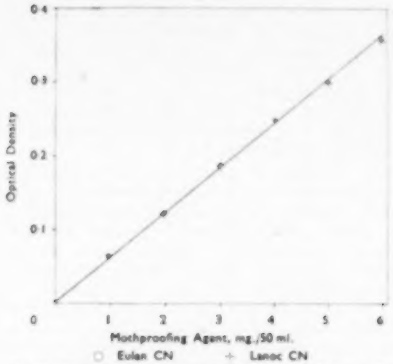


FIG. 2.—Standardisation Curves for Eulan CN and Lanoc CN

They indicate that there is a zero "blank" and satisfactory concordance with Beer's law over the range 0–6 mg. Lanoc CN or Eulan CN.

3.3 RECOVERY OF KNOWN AMOUNTS OF LANOC CN ON WOOL

Samples of white wool flannel (0·2–0·3 g.) were treated at 40°c. for 17 hr. in a solution (liquor : wool ratio 100 : 1) containing a known amount of Lanoc CN (0·5–2·0% on the weight of the wool) and 3% sulphuric acid (on the weight of wool). The known amounts of Lanoc CN were obtained by using suitable aliquots of the solution employed for carrying out the standardisation described above.

After treatment, the wool was removed from the liquor and dried, care being taken that no loss of wool occurred. The residual liquors gave negative tests for the presence of Lanoc CN, indicating that it had been completely absorbed by the wool.

When dry, the samples were extracted with aqueous pyridine, and the Lanoc CN content of each was determined as described above. The results (Table I) indicate recoveries which are regarded as adequate for an estimation of this character. Similar recoveries were obtained when Lanoc CN was applied to the wool at the boil.

TABLE I

Recovery of Known Amounts of Lanoc CN

Wool (g.)	Lanoc CN (mg.)	Lanoc CN taken (% on wool)	Lanoc CN found (mg.)	Recovery (%)
0·3	1·5	0·5	1·52	101
0·3	1·5	0·5	1·53	102
0·3	3·0	1·0	3·10	103
0·3	3·0	1·0	3·05	102
0·3	6·0	2·0	5·78	96
0·3	6·0	2·0	5·80	97
0·225	4·5	2·0	4·37	97
0·225	4·5	2·0	4·34	96

(4) Methylene Blue Method

Mitin FF, Lanoc CN, and Eulan CN are organic sulphonates [8,10] which are taken up by wool in a manner similar to acid dyes without conferring any colour on it. A general method for the determination of compounds of this kind in aqueous solution has been described by Jones [11], who has found that their anions combine quantitatively with the cation of the basic dye, Methylene Blue (*Colour Index*, No. 922). The coloured salts thus formed were quantitatively extractable with chloroform from an acidic solution without extraction of any appreciable amount of uncombined Methylene Blue. The amount of the sulphonate present is equivalent to the concentration of the coloured salt in the chloroform, this being determined absorptiometrically. The spectrophotometric characteristics of the coloured salts of a number of sulphonates were found to be identical with those of Methylene Blue chloride, the maximum optical density occurring at 652 mμ. Over the range examined (0–0·4 mg./100 ml.) the coloured solutions were found to obey Beer's law. It has now been found that the anions of these mothproofing agents react with Methylene Blue and other basic dyes to give complexes having absorption characteristics similar to those found by Jones, this being illustrated by the absorption curves shown in Fig. 3. The method

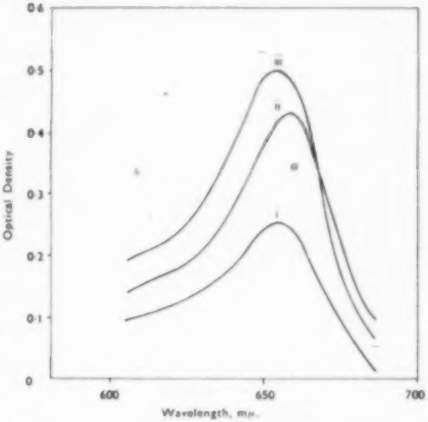


FIG. 3.—Absorption Curves of the Methylene Blue Complexes of Mitin FF and Eulan CN

can be used for the estimation of these agents in either pyridine extracts or sulphuric acid digests of wool. With both methods a "blank" is obtained of a higher order than that obtained by Jones and attributed by him to the solubility of Methylene Blue chloride in chloroform. This cannot be reduced by washing the coloured solution in water, and may be due to the effect of soap, which was found by Jones to give a weak colour to the chloroform solution. The method does not differentiate between the respective mothproofing agents, so that the identity of the one concerned must be known. A qualitative test carried out by the copper–pyridine method will indicate the presence or absence of Eulan CN or Lanoc CN. The method is obviously liable to interference by other substances of similar chemical properties, viz. certain anionic synthetic detergents.

4.1 PROCEDURE

To a 10-ml. aliquot of the sulphuric acid digest or of the pyridine extract in a 100-ml. separating funnel, 5 ml. of 0·02% Methylene Blue (medicinal grade) and 2 ml. of 5 N. sulphuric acid are added. The mixture is then extracted by gently shaking for at least 1 min. with 20, 10, and 10-ml. portions of chloroform successively, a period of 5 min. being allowed for separation. The chloroform extracts are combined in a 50-ml. graduated flask, the volume is made up to 50 ml., and if necessary about 0·5 g. anhydrous sodium sulphate is added to remove any water present. The amount of mothproofing agent is then determined either by colorimetric comparison of the coloured solution with solutions similarly prepared using known amounts of mothproofing agent or absorptiometrically.

4.2 STANDARDISATION

The readings obtained using known quantities of Mitin FF* under various conditions, including those which result from the use of both the pyridine extraction and sulphuric acid digestion methods,

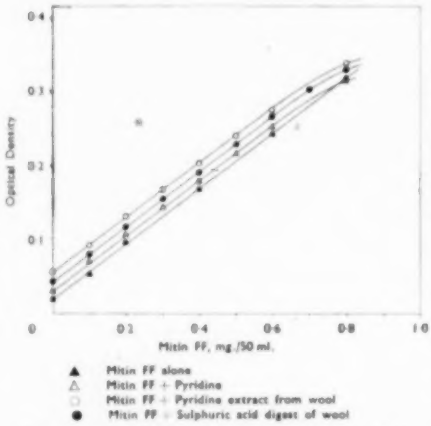


FIG. 4.—Standardisation Curves for Mitin FF-Methylene Blue

are shown in Fig. 4. They were obtained by the following methods—

(i) Aliquots containing known amounts of air-dry Mitin FF (0·1–0·8 mg.) were transferred to separating funnels, acidified, and then treated as described in § 4.1.

(ii) Aliquots containing known amounts of air-dry Mitin FF (1–8 mg.) were introduced into 100-ml. graduated flasks, 7 ml. pure pyridine was added, and the volume made up to 100 ml. with distilled water. Aliquots (10 ml.) were transferred to separating funnels, acidified, and then treated as described in § 4.1.

(iii) Samples of wool (0·3 g.) in the form of undyed worsted yarn were extracted with ethyl ether and treated in a solution containing 5% sulphuric acid on the weight of the wool at the boil for 1 hr. After drying, the samples were extracted with pyridine as described in § 2.1. Each pyridine extract was transferred to a graduated flask, an aliquot containing 1–8 mg. air-dry Mitin FF was added, and the whole made up to 100 ml. with distilled water. An aliquot (10 ml.) was then transferred to a separating funnel, acidified, and treated as described in § 4.1.

(iv) A sample of wool (3 g.) as used above was extracted with ethyl ether and dissolved in 24 ml. of 78% sulphuric acid contained in a boiling tube, the latter being immersed in boiling water for 20 min. The resulting solution was cooled and made up to 250 ml. Aliquots (25 ml. = 0·3 g. wool) were transferred to a 100-ml. graduated flask, an aliquot containing 1–8 mg. of air-dry Mitin FF was added to each, and the whole made up to 100 ml. with distilled water. An aliquot (10 ml.) was then transferred to a separating funnel, acidified, and treated as described in § 4.1.

All absorptiometric measurements on the coloured solutions prepared as indicated above were made using 1-cm. cells and an Ilford Spectrum Red Filter No. 608.

The results indicate that the intensity of colour developed in the chloroform layer is proportional to the amount of Mitin FF present up to a concentration of about 0·6 mg. per 50 ml. Above that concentration there are signs of deviation from this relation. In the absence of any other substances there is a small "blank" due to the solubility of Methylene Blue in chloroform. In the presence of pyridine this is increased, and is still further increased when a pyridine extract of wool in an acid condition is used. Wool digested in sulphuric acid solution also gives rise to a higher "blank" than that obtained in its absence.

These "blanks" are of considerable significance when either the pyridine extraction method or the sulphuric acid digestion method is used. Ideally it would appear to be desirable to standardise with solutions containing an extract or digest of the same material in the unproofed state as is being tested, together with a known amount of added Mitin FF. Such a method, apart from being inconvenient, is not likely to be generally applicable in routine work owing to the absence of the necessary unproofed sample. As an alternative, it is therefore necessary to take an arbitrary value for the "blank", and use the appropriate graph obtained in the absence of wool for standardisation.

It is of interest to note that similar results are obtained using Eulan CN over the concentration range 0–0·12 mg. per 50 ml. (Fig. 5). For the determination of Eulan CN and Lanoc CN the copper–pyridine method is, however, much preferred.

4.3 RECOVERY OF KNOWN AMOUNTS OF MITIN FF IN WOOL

(i) *Using Pyridine Extraction Method*

Samples of wool (0·3 g.) in the form of worsted yarn were extracted with ethyl ether and treated in a solution containing 1–8 mg. Mitin FF (representing an addition of 0·33–2·66% on the weight of wool) and 5% sulphuric acid (on the weight of

* The Mitin FF used was the commercial product marketed by the Geigy Co. Ltd.

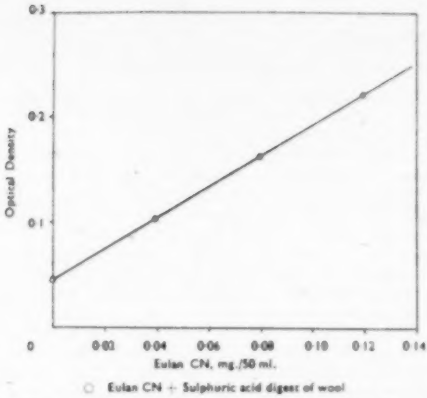


FIG. 5—Standardisation Curve for Eulan CX–Methylene Blue

wool) at the boil for 1 hr., the liquor : wool ratio being maintained at 100 : 1 throughout. After cooling, the wool was collected on a sintered glass filter, dried, and extracted with pyridine. The pyridine extracts, together with the washings of the flask, were transferred to a 100-ml. graduated flask, and the volumes were made up using first the liquor in which the samples were treated and then distilled water. In this way any Mitin FF remaining in the liquor at the end of the "dyeing" treatment was included and not lost. Aliquots (10 ml.) were then treated as described in § 4.1.

(ii) Using Sulphuric Acid Digestion Method

The procedure was identical with that outlined in (i) above, except that the wool was dissolved in 2·4 ml. of 78% sulphuric acid.

The recovery of known amounts of Mitin FF using both the above methods is given in Table II. The results are based on the appropriate standardisation shown in Fig. 4, in the preparation of which the same worsted yarn and standard Mitin FF solutions were used as in the recovery experiments.

TABLE II

Recovery of Known Amounts of Mitin FF

Mitin FF taken (mg.)	(% on wool)	Pyridine Extraction		Sulphuric Acid Digestion	
		Mitin FF found (mg.)	Recovery (%)	Mitin FF found (mg.)	Recovery (%)
1·0	0·33	0·975	97·5	1·02	102·0
2·0	0·66	2·02	101·0	2·01	100·5
3·0	1·0	2·83	94·0	2·76	92·0
4·0	1·33	3·65	91·0	3·76	94·0
5·0	1·66	4·55	91·0	4·75	95·0
6·0	2·0	5·43	90·5	5·46	91·0
7·0	2·33	6·42	92·0	6·30	90·0
8·0	2·66	7·05	88·0	7·20	90·0

The recovery of the mothproofing agent by this method is only about 90% when the amount of Mitin FF present is of the order recommended for adequate protection. Nevertheless, even at this yield the method should be of value, since an appropriate correction can be applied to the result.

(5) Note on the Application of the Methods to Dyed Wool

As noted in the introduction, difficulties may be encountered when applying these methods to dyed wool. Whether or not the estimation can be carried out will depend on the amount of dye present and its properties, viz. fastness, hue, and partition between the aqueous and chloroform media. The amount of dye removed from the wool by pyridine extraction varies widely; thus acid dyes may be completely removed, whereas chrome dyes may be largely unaffected. Actual interference in the estimation arises from coloration of the chloroform layer during the extraction. If the hue of the extracted dye is such that its absorption band does not overlap that selected for the absorptiometric measurement of the coloured complex formed by the mothproofing agent, the interference will be eliminated. If it cannot be eliminated by suitable choice of waveband, the extent of the interference may be determined by means of a "blank" determination carried out in the absence of copper sulphate. If the "blank" is high in comparison with the contribution to the total absorption made by the mothproofing agent itself, the accuracy of the method will obviously suffer.

Digestion of dyed wool in 78% sulphuric acid generally produces a coloured solution. Whether or not the colour of the dye is completely destroyed, interference in the subsequent estimation will be likely because the decomposition products of the dye, even if colourless, will be anionic in character, and hence liable to form chloroform-soluble complexes with Methylene Blue. Direct interference of this nature may be more difficult to overcome. Resort to the longer technique of acid digestion followed by ether extraction[7] may be helpful when simpler methods are unsuccessful.

* * *

The authors desire to thank Mr. K. Lees, who developed the pyridine extraction method described in connection with the estimation of dyes in wool, and the Director and Council of the Wool Industries Research Association for permission to publish this paper.

WOOL INDUSTRIES RESEARCH ASSOCIATION
"TORRIDON"
HEADINGLEY
LEEDS 6

(Received 19th February 1952)

References

[1] Hartley, R. S., Elsworth, F. F., and Barritt, J., J.S.D.C., **59**, 266 (1943).
[2] Elsworth, F. F., and Barritt, J., *Analyst*, **68**, 298 (1943).
[3] Tentative Textile Standard No. 10 (Narrow Fabrics), *J. Textile Inst.*, **35**, s 7 (1944).
[4] Bradbury, F. R., Higgons, D. N., and Stoneman, J. P., *J.S.C.I.*, **66**, 65 (1947).
[5] Gunter, F. A., *Ind. Eng. Chem., Anal. Ed.*, **17**, 149 (1945).
[6] Clark, C. O., J.S.D.C., **59**, 214 (1943).
[7] ICI, *Technical Circular*, "Lanoc CN— Properties and Test Methods".
[8] *BIOS* 1239 (H.M. Stationery Office), p. 26.
[9] Cunliffe, P. W., *J. Textile Inst.*, **34**, T 55 (1943).
[10] Lauger, P., *Helv. Chim. Acta*, **27**, 71 (1944).
[11] Jones, J. H., *J. Assocn. Off. Agric. Chem.*, **28**, 398 (1945).

CORRESPONDENCE

The Editor does not hold himself responsible for opinions expressed by correspondents

The Editor
SIR,

It has astonished me for many years that there is no lively correspondence column in our famous *Journal*. I suggest that it is a pity that items of general or particular interest are not written about in almost every issue; and particularly so if there is an argument about it.

It was the ruling of the Manchester Section in the 1930's (I think Lawrie was Chairman at the time) to invite (prior to a lecture) short comments from anyone in the audience on any matter of interest to members and not of sufficient importance to warrant a lecture. The idea was not a great success, but I do recollect a few interesting discussions. It occurs to me that the idea might be revived by inviting such items for publication as "Letters to the Editor".

Yours faithfully

H. à BRASSARD

SEADEN
EASTON BAVENTS
SOUTHWOLD
SUFFOLK

15th February 1952

The Publications Committee is in full sympathy with Mr. à Brassard in his desire for more contributions to the Correspondence Section of the *Journal*.—*Editor.*

The Editor
SIR,

The Combination of Wool with Acids

In recent years various mathematical formulæ have been applied to the quantitative adsorption of acids and acid dyes by wool. In most cases a maximum adsorption of strong acids is recognised around 0·9 milliequivalent per gram. In Lemin and Vickerstaff's paper [1], formulæ are used which are based on Gilbert and Rideal's theory, and the maximum adsorptive capacity is expressed as the number of charged sites in the wool upon which positive and negative ions are adsorbed. From these formulæ affinity constants have been calculated.

Chemical affinity is usually expressed mathematically as

$$RT \ln C_1 C_2$$

where C_1 and C_2 are concentrations, and since RT is usually given in calories, the chemical affinities are expressed in calories.

In Lemin and Vickerstaff's paper the affinity is expressed mathematically as—

$$RT \ln \frac{\left(\frac{\theta_H}{1-\theta_H}\right)\left(\frac{\theta_D}{1-\theta_D}\right)}{[H^+]\,[D^-]}$$

where θ_H and θ_D are the fractions of cation and anion sites respectively occupied by hydrogen and dye ions. The affinities are thus expressed in a manner different from chemical affinity. Whatever may be the value of these calculated affinities, it is difficult to correlate them mathematically with chemical affinities or with the results of calculations made by other formulæ applicable to the adsorption of acids by wool.

Harris and Steinhardt's formulæ [2] are based on the well known laws of mass action. Peters and Speakman [3] have shown that these formulæ agree quite well with experimental observations of the adsorption of hydrochloric acid by wool in the absence of salts providing certain values are selected for the constants, but that this agreement does not extend to the adsorption of hydrochloric acid in the presence of salt.

Since Donnan's formulæ and Procter's formulæ are also based on the laws of mass action, they should be mathematically related to Harris and Steinhardt's formulæ if the adsorption is a phenomenon of the same type and the experimental observations are complete. Harris and Steinhardt have pointed out that the difficulty of applying Donnan's theory to the adsorption of acids by wool lies in the impossibility of defining the boundary of the fibre phase and of estimating correctly its volume.

Peters and Speakman have made use of Procter's modification of Donnan's formulæ to calculate the theoretical internal pH values. At the mid-points in the titration curves, which in previous work they found at an external pH of 2·25 for hydrochloric acid and around pH 3 for sulphuric acid, they calculated the internal pH to be around 4·5 in both cases, and the same figure for hydrochloric acid in the presence of salt. The following formulæ were adopted by Peters and Speakman for their calculations—

$$\text{For HCl} \quad \ldots \quad pH_{int} \sim 2\,pH_{ext} + \log \frac{a}{v}\gamma_1 \qquad (i)$$

$$\text{For } H_2SO_4 \quad \ldots \quad pH_{int} \sim \frac{3}{2}pH_{ext} + \frac{1}{2}\log \frac{a}{v}\gamma_2 \qquad (ii)$$

where a = amount of acid combined with the wool fibre, v = volume of free water in the fibre, and γ_1 and γ_2 are constants not very different from unity.

As the value of v cannot be correctly determined, these authors selected values which, at the mid-points, bring the values of the logarithmic terms to approximately zero, so that, at the mid-points, the internal pH for hydrochloric acid becomes twice the external pH, whilst the internal pH for sulphuric acid becomes one-and-a-half times the external pH. Taking the experimentally determined values for the mid-points as 2·25 and 3·0 respectively, the internal pH at the mid-points becomes the same for both acids. This is a mathematical consequence of the elimination of the logarithmic terms by the somewhat arbitrary selection of values for v.

Until we know the correct values for v and something definite about the behaviour of solutions in extraordinarily small spaces, where the ratio of surface to volume is very high, we cannot learn much about internal concentrations.

Donnan's theory applies to the case where two solutions at the same pressure are separated by a

membrane impermeable to one ion of one solution, but completely permeable to all the other ions. The adsorption of acids by wool is obviously not an example of this type. It is also not an example of Procter's type, where a protein—gelatin—provides a salt with one indiffusible ion as well as a membrane which, being quite free to swell, adjusts its volume to the osmotic pressure developed.

In this letter I shall show that the laws of mass action which form the basis of both Donnan's and Procter's formulæ are applicable to the adsorption of acids by wool once the conditions have been exactly defined and the differences between the conditions in the experimental work of Donnan, Procter, Harris, and others have been established.

I had the privilege of knowing the late Prof. H. R. Procter and of discussing with him all the experimental work carried out on the swelling of gelatin under his direction, and I also discussed the problem with the late J. A. Wilson.

In Procter's experimental work all the data were obtained directly by measurement and analysis; the actual volume of liquid in the gel was measured, as well as the concentrations of acid in both the gel phase and the external solution. The work was a fine example of a complete set of experiments leading to a definite conclusion. Such a complete set of experiments has not so far been carried out with wool.

There was much more in Procter's work than an application of Donnan's equations to a new phenomenon. Procter demonstrated that the phenomena relating to the swelling of gelatin depended on the formation and hydrolysis of a compound of gelatin with hydrochloric acid similar to the hydrochlorides of weak organic bases like aniline. He equated the amounts of acid adsorbed by the gelatin not with the concentration of acid within the gel but with the concentration of acid in the external solution. The equation used by Procter is—

$$a = \left(\frac{x}{x + 0{\cdot}0013} + \frac{x}{x + 1{\cdot}05}\right) \times \frac{1000}{839} \qquad \text{(iii)}$$

and represents the hydrolysis of the hydrochloride of a diacid base of molecular weight 839, where a is the amount of acid adsorbed by one gram of gelatin and continually increases with x, the external concentration. Procter expressed the opinion that similar results should be obtained with all proteins, but, knowing his views, I am confident that he referred to such proteins as swell in water in a manner similar to gelatin.

The recorded data for the adsorption of acids by wool do not fit an equation of the type used by Procter, the maximum adsorption being attained before the concentration x reaches unity; moreover, the wool does not swell appreciably. It is quite likely that with acids which may cause considerable swelling, a formula of Procter's type might be applicable. I am of the opinion that the two terms in Procter's formula apply to different groups in the gelatin molecule, one applying to an NH_2 group and the other to the NH–CO linkage, the latter becoming more accessible as swelling proceeds.

If, in the case of wool, we assume that all or most of the free NH_2 groups form salt-links with free COOH groups, and that these salt-links are broken when the wool is placed in acids, some or all of these NH_2 groups will take up a molecule of strong acid in which both ions combine. The NH_2 groups which have not adsorbed the strong acid will remain joined to the acidic COOH groups of the wool, in which only the hydrogen ion is active and diffusible, the negative COO^- being not only indiffusible but substantially fixed in position. In both cases the basic constituent of the wool is indiffusible and substantially fixed in position.

In both Donnan's and Procter's experiments only one indiffusible ion is considered to be present; in the latter case this indiffusible ion is attached to the gelatin and is not free to move, whereas in Donnan's experiments the ion is free to move but cannot pass through the membrane. In wool there are two indiffusible ions and both remain substantially fixed relative to one another so long as no appreciable swelling takes place. There is one other important difference to be considered, namely that the indiffusible acidic carboxyl groups in wool can pass only one ion to the basic groups, whereas both ions of a freely diffusible acid attach themselves to basic NH_2 groups; this very important condition was not taken into account by Harris and Steinhardt.

The essential differences between the conditions just defined for the reactions between wool and acids and those existing in the experiments of Donnan and of Procter will now be clear, and one can proceed with the mathematical treatment of the adsorption of acids by wool on the basis of the mass-action laws.

The phenomena which occur when wool is placed in a solution of an acid are similar to those which occur when a weak base is distributed between two acids, for which mathematical formulæ have already been devised and are to be found in most books on physical chemistry. Modification is needed mainly because in the case of wool one of the acids has an indiffusible ion, whereas in the standard formulæ both acids are regarded as ionised and both ions diffusible in both acids.

Let—

z = Proportion of active but indiffusible basic groups of wool which combine with freely diffusible acid.

$1-z$ = Proportion of indiffusible basic groups combined with the indiffusible acidic groups of the wool.

C_1 = Concentration of diffusible acid at equilibrium.

C_2 = Concentration of indiffusible acid at equilibrium.

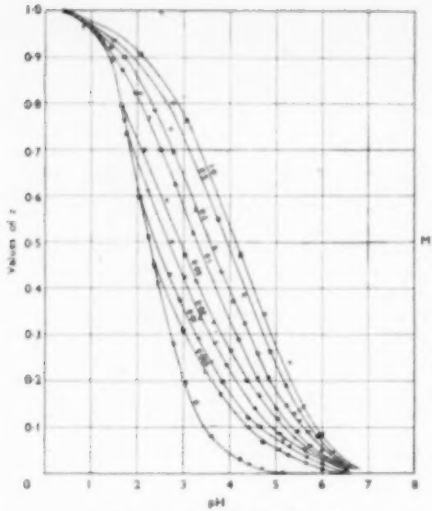
Then—

$$\frac{z}{1-z} = \frac{K_1 C_1}{K_2 C_2} \qquad \text{(iv)}$$

where K_1, K_2 are the corresponding acidic ionisation constants. C_2 is obviously directly proportional to z, since it represents the proportion of indiffusible acid groups set free by the diffusible acid; its value cannot be experimentally determined.

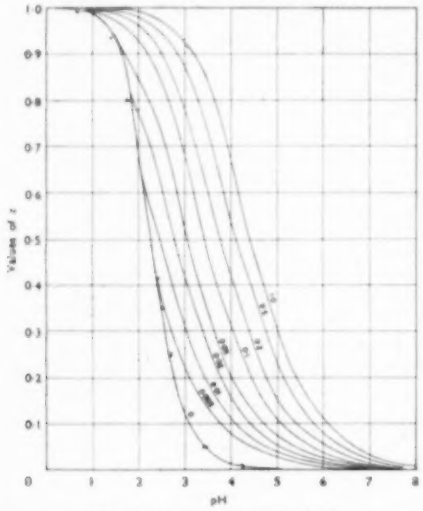
In accordance with the laws of ionisation we can write—

$$\frac{[H^+]\,[A^-]}{[HA]} = K_1$$



Figures on curves show normality of KCl
M ... Breadth at midpoint 1·85 pH units (theoretical breadth 2·15)

FIG. 1.—Experimental Data for Hydrochloric Acid–Potassium Chloride Solutions (Steinhardt and Harris[2])



Figures on curves give normality of KCl
X ... Experimental Results from Peters and Speakman[3] (Table II)
$k = 6{\cdot}3 \times 10^{-5}$

FIG. 2.—Theoretical Curves calculated from Equation (vi)
$(k = 6{\cdot}3 \times 10^{-5})$

for the diffusible acid, and instead of K_1C_1 we can put $[H^+] \times [A^-]$, or $[H^+]^2$ in the case where no salts are present. As C_2 is proportional to z, we can replace K_2C_2 by kz, and equation (iv) then becomes—

$$\frac{z}{1-z} = \frac{[H^+]^2}{kz}$$

or $$kz^2 = [H^+]^2 - [H^+]^2 z \qquad (v)$$

Hence

$$z = \frac{-[H^+]^2 + \sqrt{[H^+]^4 + 4k[H^+]^2}}{2k}$$

or $$\frac{-[H^+][A^-] + \sqrt{[H^+]^2[A^-]^2 + 4k[H^+][A^-]}}{2k} \qquad (vi)$$

It is easy to calculate the constant k from the conditions at the mid-point, which in the case of hydrochloric acid we may take at pH 2·25, when we find $k = 6{\cdot}3 \times 10^{-5}$.

In the case of sulphuric acid, where two equivalents give only three ions as compared with four for hydrochloric acid, $[H^+]^2$ is replaced by $[H^+]^{3/2}$. Without changing the constant k, the above equation gives pH 3 for the external hydrogen ion concentration at the mid-point for sulphuric acid.

In the case of hydrochloric acid in presence of salt $[H^+]^2$ is replaced by $[H^+] \times [A^-]$.

A set of calculations from these formulæ has been made for different pH values for hydrochloric acid with and without the addition of potassium chloride, and the results have been plotted in curves for comparison with the experimental results of Speakman and Stott and of Harris and Steinhardt. Considering the relatively large experimental error, the correlation is reasonably good. It is assumed in these calculations that the potassium chloride is fully ionised, which is not likely to be true at the higher concentrations, where the difference between observed and calculated values is noticeable.

In the absence of experimental evidence, it is impossible to say how the internal concentration of acid differs from the external concentration. We cannot in fact discuss internal concentrations until we know the volume of liquid in the fibre phase, and even then we would have to assume that the conditions in exceedingly small spaces were similar to those in large volumes. That such is unlikely will be shown in a later paper dealing with dyeing.

Yours faithfully

W. HARRISON

6 HATHERLEY COURT ROAD
CHELTENHAM

7th November 1951

[1] Lemin and Vickerstaff, J.S.D.C., **63**, 405 (1947).
[2] Steinhardt and Harris, *Bur. Stand. J. Res.*, **24**, 345 (1940).
[3] Peters and Speakman, J.S.D.C., **65**, 63 (1949).

The Editor
SIR,

A Light-Time Integrator for Use in Daylight Fading

There have been several previous descriptions of light integrators suitable for use in photochemical work, e.g. fading of dyes, where the amount of radiant energy incident on a surface requires to be recorded [1–3]. An instrument of this type has been constructed in this laboratory for use in daylight fading. As much of this work involves exposures

over quite long periods, extending over several months, one of the main requirements of the instrument is reliability in continuous service. It was with this consideration in view that the present instrument was constructed, in which the thermionic valves previously used have been replaced by a cold-cathode valve.

The method of integrating the photocell current using a capacitor and discharge tube across it is similar to that used by Davenport [1]. The pulse developed is used to trigger the cold-cathode valve, which energises the relay in the anode circuit. The relay actuates a mains-operated counter and also breaks the anode circuit to allow the cold-cathode valve to return to the non-conducting state. To prevent chatter at the contacts, the relay carries a slug causing a slight delay in the closing of the anode circuit. This was found to be more satisfactory than a capacitor across the contacts.

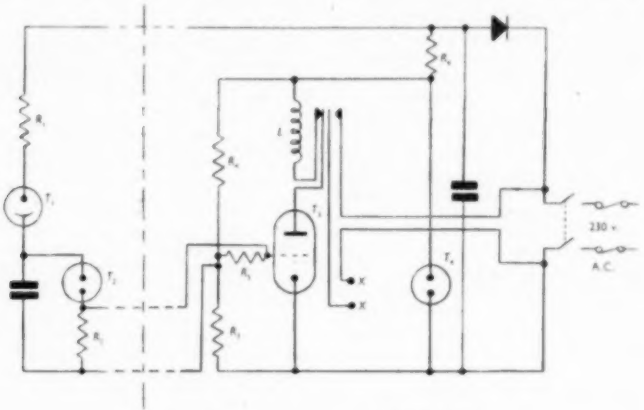
The pulse applied to the grid is not sufficient alone to trigger the valve; so a steady positive bias is applied of 6–10 v. below the triggering voltage (approx. 80 v.).

The anode and grid potentials are obtained across an S 130 stabilising tube, which maintains the required conditions steady and dispenses with an otherwise large bleeder resistor.

The instrument is constructed in two separate units, the photocell, associated capacitor, and discharge tube being contained in a sealed metal box with desiccator which is placed on the roof. The capacitor is a special high-insulation type; and the Mullard 7475 discharge tube, which has been recommended by S. F. Adams [4] as free from initial current flow prior to striking, has been used with the base removed.

The remaining components are housed in a small case within the laboratory, and connected by a three-core cable to the photocell unit.

For convenience over long periods a six-figure counter has been used in preference to the four-figure P.O. type. For daylight recording the rate of counting ranges from about 8 per minute for bright sunshine down to 4 per hour on a dull day. The counting rate was adjusted to lie within these limits by adjusting the diameter of a diaphragm interposed between the diffusing entrance window and the photocell.



Resistances (ohms)			Relay and Tubes		
R_1	...	250×10^3	L	...	P.O. 3000 Relay with slug
R_2	...	50×10^3	T_1	...	VB 39 (Cintel)
$R_3 = R_4$	...	33×10^3	T_2	...	7475 (Mullard)
R_5	...	$1{\cdot}8 \times 10^3$	T_3	...	K 3 (Ferranti)
R_6	...	6×10^3	T_4	...	S 130

XX ... Connected to mains-operated counter (Veeder-Root)

The instrument has been continuously running for over nine months without attention except for a periodic replacement of the desiccator in the photocell unit.

It has been thought worth while to keep a reference lamp, which can be run under standard conditions, to check periodically the constancy of the light sensitivity, as it is possible that a small change may occur in the sensitivity of the photocell or the striking voltage of the discharge tube.

Yours faithfully

P. H. Oliver

Research Laboratories
Courtaulds Ltd.
Droylsden
Manchester

12th March 1950

[1] Davenport, *J. Sci. Instrum.*, **26**, 305 (1949).
[3] Atherton and Seltzer, J.S.D.C., **65**, 634 (1949).
[3] Atherton, *ibid.*, **66**, 545 (1950).
[4] Adams, S. F., Private Communication.

Notes

Proceedings of the Council

At a meeting of the Council held at the Victoria Hotel, Bradford, on 12th March 1952, the proceedings included the following items of interest—

SUMMER SCHOOL—It was reported that the programme of lectures and practical work was now almost complete. Mr. W. A. Edwards and Mr. C. W. Edwards had been elected Chairman and Honorary Secretary, respectively, of the Committee.

INTERNATIONAL FEDERATION OF ASSOCIATIONS OF TEXTILE CHEMISTS AND COLOURISTS—It was decided that the Society would be represented by an observer at a preliminary meeting to be held in Basle on 29th March 1952 to discuss the revival of the Association, which had been inactive since the outbreak of war in 1939.

MEMBERSHIP — Thirteen applications for ordinary membership and two for junior membership were approved. Mr. H. Ecker was readmitted to membership of the Society.

RETIRING MEMBERS OF COUNCIL—The President thanked retiring Vice-presidents and Ordinary Members of Council for their past services.

RETIRING PRESIDENT—Mr. F. Scholefield was warmly thanked for his chairmanship of Council meetings and other services to the Society during the past two years.

Meetings of Council and Committees

April

Council—9th
Finance—9th
Publications—16th
Review of Textile Progress—7th
Colour Index Editorial Panel—25th
Fastness Tests Co-ordinating—17th
Summer School—5th

Death

We regret to report the loss by death of Dr. G. Ullmann.

Dyestuffs Controller

Resignation of Mr. G. E. Holden

The Board of Trade announces with regret the resignation of Mr. G. E. Holden, C.B.E., the Dyestuffs Controller. Mr. Holden has held this honorary appointment for the last five years, and the President of the Board of Trade has expressed his warm appreciation of the valuable services he has rendered during his period in office and for many years previously.

Mr. Holden was President of the Society from 1948 to 1950.

It is not intended to replace Mr. Holden in the appointment of Dyestuffs Controller; instead, the Dyestuffs Advisory Committee will be reconstituted, and Sir William Palmer, K.B.E., C.B., has accepted an invitation from the Board of Trade to become the independent chairman of the new committee.

The Dyestuffs Control will in future be known as the Dyestuffs Office.

Recommended Definitions

The Terms and Definitions Committee is grateful to those who have sent in comments on its tentative definitions, and now puts forward the following as *recommended* definitions, based on the tentative definitions already published (J.S.D.C., **67**, 194 (May 1951))—

1. AFFINITY

(*Qualitatively*) AFFINITY is the attraction between a substrate and a dye or other substance under the precise conditions of test whereby the latter is selectively extracted from the application medium by the substrate.

(*Quantitatively*) The AFFINITY of a dye for a substrate may be expressed as the difference, in gram-calories per gram-molecule, between the chemical potential of the dye in its standard state in the fibre and the corresponding chemical potential in the dyebath.

2. COLOUR

(*a*) That characteristic of the visual sensation which enables the eye to distinguish differences in its quality, such as may be caused by differences in the spectral distribution of the light rather than by differences in spatial distribution or fluctuations with time.

(*b*) As (*a*), but applied directly to the stimulus or the source (primary or secondary) giving rise to the sensation. For brevity the stimulus is often referred to as the colour.

(*c*) That property of an object or stimulus, or quality of a visual sensation, distinguished by its appearance of redness, greenness, etc., in contradistinction to whiteness, greyness, or blackness (i.e. chromatic colour in contradistinction to achromatic colour).

The above definitions of colour are those recommended by the Physical Society Colour Group (*Report on Colour Terminology*, p. 4).

Tentative Definitions

The Terms and Definitions Committee will welcome comments on the following tentative definitions—

9. SHADE

(*Noun*) The definition of the colour when it is not expressed directly in terms of the light selectively reflected from, or transmitted by, the body or of the corresponding subjective impression, but by analogy of association of ideas, e.g. mode shade, lavender, eau-de-nil.

(*Verb active*) To shade, to bring about relatively small modifications in the colour of a body; in dyeing, by the addition of small proportions of dye in comparison with those already present, especially with the object of matching more accurately with a given pattern.

10. STRENGTH, DEPTH

That colour quality, an increase in which is associated with an increase in the quantity of dye present, all other conditions (viewing, etc.) remaining the same.

The above is the definition of *strength* recommended by the Physical Society Colour Group (*Report on Colour Terminology*, No. 146, p. 25). The Committee has agreed that *strength* and *depth* should be regarded as synonymous, no preference being expressed for one or the other.

11. STRONG, DEEP, FULL

12. WEAK, PALE, EMPTY

Adjectives applied to colour produced by the application of a relatively large (small) amount of dye.

The above are the Physical Society Colour Group's definitions No. 150 and 151 (p. 27). Again no preference is expressed for any of the synonyms *strong, deep, full*, or for any of their antonyms *weak, pale, empty*.

13. DULLNESS

14. BRIGHTNESS

The definitions recommended by the Physical Society Colour Group (No. 147 and 148, p. 26)—

That colour quality, an increase (decrease) in which may be compared with the effect of the addition of a small quantity of neutral grey dye to the dyestuff, whereby a match cannot be made by adjusting the strength.

SUBSTANTIVITY

Synonym for *affinity* (q.v.).

Manchester College of Technology

It is reported that the Manchester Education Committee has agreed to a proposal by the governors of the College to set up a chair in textile chemistry.

Dye Manufacture in Spain

Spanish dye production in 1950 was about 1630 tons, or 51% of estimated total capacity. The weights in tons of the different classes of dyes were—sulphur 690, direct and union 608, acid and chrome 260, and basic 73. Dye imports amounted to 478 tons, of which 45% came from Germany.

Verein Deutscher Färber

The Verein Deutscher Färber, with its headquarters in München-Gladbach, now includes eight local sections—Niederrhein, North and South Württemberg, North and South Bavaria, the Palatinate, Bergisch-Land, and Oberberg. A section covering the Eifel region (including Aachen) is in course of formation.

Enkalon and Akulon—Dutch Nylon

Enkalon and Akulon are fibrous and granular forms of nylon developed in Holland by the Algemeene Kunstzijde Unie in co-operation with the Netherlands State Mines. Enkalon yarn is now in full-scale production at Emmen. c o c

Pan (CFM)—Polyacrylonitrile Fibre

As a result of work started in 1934 the Cassella Farbwerke Mainkur are about to start manufacture of a polyacrylonitrile fibre which will be known as Pan. c o c

Japanese Production of Man-made Fibres

Japan has now a rapidly expanding viscose rayon production and in addition has four plants producing polyvinyl alcohol fibre, two producing nylon, and one producing polyvinyl chloride fibre. c o c

Cetalon—Japanese Fibre from Shark Waste

Cetalon is a recently introduced fibre made in Japan from shark waste. Potential production is 50,000,000 lb. per annum. Its main use appears to be as a substitute for wool. c o c

Colour Sensitivity of the Retina

Recent work in the U.S.S.R. has shown [1] that any non-visual stimulation that increases retinal sensitivity to green light appears to decrease it to red light. Substances which heighten sympathetic excitability, such as adrenaline and ephedrine, increase retinal sensitivity to light in the green–blue region of the spectrum. Substances which heighten parasympathetic excitability, such as pilocarpine, increase sensitivity to light in the orange–red region.

[1] Reviewed by I. D. London, *Science*, **114**, 227–233 (1951); quoted in *Nature*, **169**, 26 (5th Jan. 1952).

Authors of the Same Name

A survey undertaken for the Bureau of Abstracts [1] reveals *inter alia* that of 838 Smiths currently contributing to chemical literature 56 pairs, 51 trios, 37 quartets, 20 quintets, 10 sextets, 9 septets, 3 octets, 2 nonets, 2 decets, and one group of eleven have identical initials. Among possible methods of diminishing the difficulties resulting from such duplication of names in indexing are—(i) that names should not be shortened in abstracts, (ii) that a list of "dual or multiple personalities" should be maintained, (iii) that initials should always be cited in references, and (iv) that abstracts should include the addresses of authors.

[1] Dyson, G. M., *Chem. and Ind.*, 210 (8th March 1952).

University of Tübingen

It is reported that a new institute for the study of chemical technology, macromolecular chemistry, and fibre science is under construction. The new chair which has been created will be occupied by Professor Eugen Müller.

OBITUARY NOTICE

Sam Heap

The death of Mr. Sam Heap, M.Sc., last December has robbed the Society of one of its distinguished members, and the Manchester Committee of a valued friend.

Elected a member of this Committee in 1932, he proved most active and helpful in its service, being Vice-chairman from 1936 to 1938, Chairman from 1938 to 1940, and finally retiring in 1947. His large and ripe experience of the dyeing industry as Chairman of Samuel Heap & Co. Ltd., of Rochdale, together with a compelling charm of manner, was invaluable both in guidance on matters of policy and in choice of subjects and lecturers for the yearly programmes.

He translated his knowledge of the scientific side of the industry into its practical application, particularly in the development of rayon dyeing, an admirable example of the carrying into practice of the results of scientific research.

His further work as a member of Council from 1945 to 1948 gained him the respect and affection of a wider circle of friends, who greatly regretted the illness which prevented any more active work for the Society.

His death took place just when the Society was about to recognise his fifty years of membership by making him a life member.

The Society of Dyers and Colourists owes a great deal to men of the calibre of Mr. Sam Heap.

G. M. Williams

New Books and Publications

Précis de Teinture des Fibres Textiles

By Maurice Robinet. Second edition 1951. Pp. xxxii + 741. Paris: Éditions Teintex. Price, 4000 francs (France), 4500 francs (foreign).

Apart from water treatment, M. Robinet's manual deals with almost all the subjects covered by a lecture and laboratory course in dyeing.

A notable feature of the book is the long (117 pp.) and excellent chapter devoted to colour and its measurement. Considerably less space is given to textile fibres. It is surprising to find acid dyes, premetallised dyes, chrome dyes, and direct cotton dyes all in the same chapter under the heading "Acid Dyes", although this arrangement can be justified from the chemical point of view. Basic dyes and mordant dyes (madder and other natural colouring matters) receive separate attention, but the amount of space devoted to them and to such topics as "Tanning Matters" is scarcely in accordance with present-day practice. Azoic dyes, Aniline Black, and fur dyes are dealt with in a single chapter under the heading "Colours developed on the Fibre", but separate chapters are devoted to sulphur dyes and vat dyes. Further chapters deal with detergents, metallic mordants, manufacture of dyes and intermediates, and oxidising and reducing agents. There is also a good introduction to textile printing in a chapter devoted to the subject. The approach throughout the book is that of the chemist rather than that of the practical dyer.

The more practical aspects of dyeing are not neglected, however, but are dealt with in a chapter on wet finishing processes and a further long chapter which covers dyeing machinery, the dyeing of different fibres in various forms, rayon dyeing, and union dyeing. The latter chapter contains a number of useful line drawings, including one of the du Pont Multilap machine.

The final chapter on theories of dyeing is not very satisfactory, too much space being given to work carried out before 1900. Whilst reference is made to recent work, no attempt is made to provide a comprehensive theoretical background based on modern knowledge of fibre structure and the mechanism of dyeing processes. It seems probable that here the author has been content to patch up the first edition published in 1936, instead of scrapping this chapter and rewriting it.

From the factual point of view, as distinct from the method of approach, M. Robinet's book is remarkably up to date. Thus, mention is made of Orlon, dynel, and Terylene, and of recent developments in continuous piece dyeing such as the Standfast molten metal machine. Delay in the publication of books would appear to be much less serious in France than in this country.

M. Robinet has shown that it is still possible to cover the whole field of dyeing technology within the covers of a single volume. His book should prove of value not only as a text-book for students, but as a reference book for all those concerned with the coloration of textile fibres. C. L. Bird

The Trowbridge Woollen Industry as illustrated by the Stock Books of John and Thomas Clark 1804-1824

Edited by R. P. Beckinsale. Pp. xxxvi + 249 + 2 plates. Devizes: Wiltshire Archæological and Natural History Society, *Records Branch*, 6 (for 1950). 1951. Price, 25s. 0d.

It has long been known that Messrs. J. & T. Clark possess a most valuable set of business records, including pattern books going back into the eighteenth century, and some of these are now made available to those who are unable to visit Trowbridge. The greater portion of the book under review consists of a transcription of the firm's stock books or, as we should now term them, annual statements of accounts for the years 1804–1824. The accounts for 1804 and 1805 are given in full, whereas those for the later years have been abridged. They give an interesting picture of the West of England woollen industry at a time when steam power was coming into use; thus up to 1815 all Clarks' machinery was worked by man or horse

power, but that year saw the starting up of a 10 h.p. steam engine.

During the period under consideration the dyeing done at Clarks' was mainly that of loose wool, but piece dyeing increased in the later years, and throughout the period much cloth was sent out to public or, as we should term them, commission or country dyers. The dyestuffs in use and their prices are clearly shown. Most dyestuffs cost only a few pence per lb., but there were exceptions: in 1812 cudbear was valued at 2s., flora indigo at 13s., and cochineal at 42s. per lb. It is interesting to note the large variety of different types of madder used.

The accounts are preceded by an introduction in which Dr. Beckinsale, who is to be heartily congratulated on the admirable way in which he has transcribed these stock books, discusses not only them but in addition the whole history of the firm of Clarks and many aspects of the history of the Trowbridge woollen industry. It is unfortunate that he did not have this introduction read before publication by someone versed in the knowledge of the use of dyes and the technical history of the wool cloth trade. Thus the statement on p. xvi that the tin would be used in the dyeing of cotton is questionable: it might be, but as it appears in the books only when cochineal appears, it is much more likely that it was used as a mordant for cochineal scarlets on wool. Again, not every reader will appreciate that the "undressed" cloths referred to on p. vii as being exported to the Continent were not in the loom state but had been milled, often heavily milled.

However, these and other misunderstandings by the author of the technology used in those days do not detract from the value of the book to all interested in the history of the woollen industry and of the dyeing, scouring, and finishing processes used in it. C. O. CLARK

A Text-book of Practical Organic Chemistry including Qualitative Organic Analysis

By A. I. Vogel. Second edition 1951. Pp. xxiii + 1033. London: Longmans, Green & Co. Price, 50s. 0d.

This is an excellent text-book for students of practical organic chemistry, and indeed will be of no little value to the practising organic chemist. A wealth of up-to-date practical information is available in its chapter on experimental technique and in the 600 odd preparatory methods, among which are a number of recipes for azo and other dyes. These detailed preparations are grouped into the conventional classes of organic chemistry, the reactions and methods of characterisation of the various classes also being described. This, together with melting and boiling point tables and a general chapter on qualitative organic analysis, makes the book an excellent one for this purpose also. No attempt is made to deal with quantitative analysis.

An introductory chapter giving a clear and readable account of the theory underlying the operations of organic chemistry admirably shows in its proper perspective the relationship of physical to practical organic chemistry.

In this edition (the first appeared in 1948) minor errors of the text have been corrected and a number of additions have been made. These include an extension of the section on organic analysis and the addition of a section dealing with more advanced preparations such as reactions in liquid ammonia, reductions with lithium aluminium hydride, and syntheses with organolithium compounds.

The book is tastefully printed and bound with numerous clear and informative diagrams and a comprehensive index. It is altogether worth its price of 50s. F. K. SUTCLIFFE

Styrene

By A. L. Ward and W. J. Roberts. Pp. v + 126. New York: Interscience Publishers Inc. 1951. Price, paper, $3.50.

In view of the importance of styrene as a raw material for the production of high polymers, a monograph dealing with the fundamental physical and chemical properties of this compound is welcome, and the authors have presented a concise review of its chemistry and technology.

After an introduction and outline of laboratory preparative methods, a brief account of the commercial production processes is given. This is followed by a particularly important chapter on the effect of impurities and methods of purification, and as many impurities only need to be present in trace amounts to have an appreciable effect upon the molecular weight and properties of the final polymer, any research worker new to the field of styrene chemistry should find this chapter most useful. Analytical methods are also included for the estimation of the common impurities.

Naturally the largest section of the monograph deals with the homo- and co-polymerisation processes, and typical laboratory and plant techniques are described; but in view of the increasing importance of styrene as a source of other chemicals, the characteristic reactions of styrene are also described, and a collection of physical, thermodynamical, and spectral data is included.

This is an essentially practical book of basic facts and processes, and as such, in conjunction with its extensive bibliography, it should make a very valuable reference book. W. S. SHORT

Manufacturers' Publications and Pattern Cards

The Society does not accept any responsibility with regard to the statements in the following notes.
Any publication abstracted may be referred to by members of the Society on application to
Dr. C. B. Stevens, Dyeing Department, Leeds University.

Badische Anilin- und Soda-Fabrik

DYEINGS ON COIR YARN.—This pattern card includes twenty-nine dyeings of acid dyes, thirty-two of basic dyes, and ten of Indanthren vat dyes on raw, unbleached coir yarn. Acid dyes are recommended for ease of application, basic dyes for dyeings of maximum brightness, and the selected Indanthren dyes for maximum fastness to light and wet treatments, although it is pointed out that coir dyed with the third class cannot be considered to exhibit the "Indanthren" standard of fastness.

Imperial Chemical Industries Ltd.

DYESTUFFS FOR "TERYLENE" POLYESTER FIBRE.—This card contains dyeings on Terylene and on Terylene–cotton material. Dyeings of six individual disperse dyes and twelve mixtures produced with this type of dye are shown dyed at 100°C. for 90 min. in presence of 1 g. Dispersol VL per litre. Disperse dyes have also been employed for the five direct prints illustrated. A further six dyeings on yarn are included, in which a modified azoic technique has been used. The coupling and diazotisable components are applied together from an aqueous dispersion at 100°C., and the colour is developed by treating the material in a cold solution of sodium nitrite and hydrochloric acid; the material is then thoroughly rinsed and soaped at the boil. The dyeings on the Terylene–cotton union include a solid and two multicolour effects and one using a diazotisable direct cotton black in which the Terylene is undyed; a single-bath process is employed. A final two-colour dyeing is shown produced by a two-bath process using a vat green on the cotton and *p*-nitroaniline coupled to 2:3-hydroxynaphthoic acid on the polyester fibre.

CHLORAZOL BRILLIANT PURPURINE 8B.—This direct dye is recommended for producing bright full bluish reds on all types of cellulosic materials. It is particularly useful where brightness of hue is essential and fastness to light and wet treatments of only minor importance. By adding urea to the printing paste the solubility of this dye may be improved sufficiently for it to be direct-printed on cellulosic fibres, chlorinated wool, and silk. It is suitable for coloured discharges in all depths, and pale to medium depths may be discharged to a satisfactory white. Fastness figures on cotton include—Light 2, perspiration 2, washing (mild, once at 40°C.) 2.

LISSAMINE FLAVINE FFS.—This is a very level-dyeing acid dye which yields outstandingly bright greenish yellows. It is of particular interest for bright oranges, pinks, and greens on knitted underwear and handknitting yarns in combination with Lissamine Rhodamines 8B and 6B and Disulphine Blue VN8. It may be printed on wool and silk, and may also be used as an illuminating colour in discharges on these fibres. Fastness figures on wool include—Light 3, perspiration 2, washing (once at 40°C.) 3–4.

THE BLEACHING AND DYEING OF "ARDIL" PROTEIN FIBRE AND "ARDIL" FIBRE UNIONS.—This technical circular is primarily concerned with the dyeing properties of this regenerated protein fibre and unions of it with wool or cellulosic fibres. The whole range of acid and chrome dyes has been examined under the most severe dyeing conditions and the dyes in each group have been classified according to—(1) their suitability for use on Ardil alone or in unions, (2) their suitability on unions, especially if dyeing is carried out below 100°C.—this class, however, is to be used only if no suitable alternatives are available in class (1); and (3) dyes which are completely unsuitable for use on either Ardil alone or unions. Separate sections deal with the dyeing and fastness properties of the level dyeing, acid, milling acid, chrome, and Ultralan dyes, and special reference is made to the possible effect on the dyeing of the presence in the fibre of large amounts of retained acid or alkali, particularly when applying acid and chrome dyes from essentially neutral dyebaths. Further sections describe the dyeing of Ardil–cellulosic fibre unions with direct dyes and give a short list of selected vat dyes. A final section includes a list of chrome dyes and a group of three Ultralan dyes recommended for use if the cellulosic component is to be reserved or only slightly stained.

CHLORAZOL COPPER BLUE B.—This direct dye is recommended for producing navy blues on all types of cellulosic material. Aftertreatment of dyeings with copper sulphate reddens the hue and increases the fastness to light. Dyeings on spun rayon are reddened and the light fastness is slightly reduced by crease-resist finishing. This dye is of little interest for direct printing, but can be used for both white and coloured discharges. Fastness figures on cotton (aftercoppered) include—Light 5, washing (repeated mild, five times at 40°C.) 2, water 3–4.

DYESTUFFS FOR GARMENT DYERS.—This is an extremely elaborate pattern book containing details for dyeing a very wide range of union materials, each section being illustrated by a comprehensive range of dyeings. Sections are included on wool–cotton unions dyed by the one-bath and two-bath processes; all wool garments and faded wool goods (for which the Chlorazol Union CF range of dyes is recommended); cotton and linen materials; silk and unions of silk with cotton, regenerated cellulose rayon, and wool; acetate rayon and mixtures therewith; and nylon. In addition a section illustrating the Altex Union dyes designed for dyeing solid shades on cellulosic–acetate rayon–silk–wool mixtures is included, and finally one showing the Chlorazol Tinting range for use on raincoats. The text also includes notes on the dyeing of leather goods, the stripping of dyed articles, auxiliary products for the garment dyer, the identification of textile fibres, sorting, cleansing before dyeing, and garment-dyeing machinery.

Sandoz Products Ltd.

CUPROFIX "C" COLOURS AFTERCOPPERED.—This card contains dyeings in two depths on cotton and spun viscose rayon of twenty Cuprofix C dyes. This group yields dyeings on cellulosic materials the fastness of which when aftertreated with copper sulphate is only very slightly lower than when Cuprofix S is used.

SHADES ON WOOL–NYLON FOR HALF HOSE.—This card illustrates a range of fourteen dyeings on knitted fabric produced from a wool–nylon yarn containing 20% of nylon staple fibre. Chrome dyes and selected acid dyes have been used. When dyeing pale shades, Sandopan LM conc. has been added as a restraining agent on the nylon; when chroming, it is recommended that at least half as much bichrome as dye be used, and chroming be continued for 60 min. at the boil.

TEXTILE CHEMICALS.—This booklet is supplementary to the one issued by Sandoz Ltd., Basle, in 1946. It describes in greater detail the properties, uses, and applications of their auxiliary products manufactured in Bradford for use in the textile industry.

Abstracts from British and Foreign Journals and Patents

(The titles of abstracts may be modified. Abbreviations of names of firms are listed in J.S.D.C., **68**, *23 (Jan. 1952); while other abbreviations and symbols, together with a list of the periodicals abstracted, will be found at the end of the annual index.)*

I—PLANT; MACHINERY; BUILDINGS

PATENTS

Homogeniser. Ormerod Engineers. *BP* 667,050
A machine in which a positive-displacement piston pump (driven by fluid under pressure) forces the emulsion through a homogenising head. C. O. C.

Chemical Treatment of Loose Fibres, Cloth, etc. J. Dungler. *BP* 666,188
The material is impregnated with the treating liquid, and then hot gas is directed perpendicularly on to it from a succession of individual jets each delivering the gas at sufficient force to penetrate the material and so cause the desired action both on the surface and in the body of the material. This greatly reduces the time necessary for treatment with the hot liquor. C. O. C.

Thread-advancing Reel. Courtaulds. *BP* 667,831

Wet Treatment of Thread on a Thread-advancing, Thread-storage Device. Industrial Rayon Corpn. *USP* 2,562,199

Heating Travelling Threads. Courtaulds. *BP* 665,160
In the stretching of heated thermoplastic threads, tension on the travelling thread is kept uniform by a device which compensates changes in tension in the thread by changing the temperature in the heating chamber. W. G. C.

Dyeing and Bleaching Tanks for Slubbing. Welding Technical Services. *BP* 666,610

Warp-sizing Machine. Springs Cotton Mills. *USP* 2,565,407

Dyeing Beam. Morton Machine Works. *USP* 2,565,729
An improved method of connecting the ends to the perforated cylinder is described. C. O. C.

Size Box for Warp-sizing Machine. U.S. Secretary of Agriculture. *USP* 2,564,725

Hank-dyeing Machine. E. A. Stienen. *USP* 2,562,220
A circulating machine in which the tank opens to receive the yarn, thus avoiding the lifting of heavy weights, is described. C. O. C.

Cleansing and Drying Continuously Moving Fabric. J. P. Stevens & Co. *USP* 2,565,576
The fabric passes over a table and beneath a dome which forms an airtight compartment over the centre of the table. At the inside edge of the dome, cleansing liquor flows in a thin film on to the fabric passing between the dome and the table. In the centre of the table covered by the dome there is a slot over which the fabric passes. On the fore edge of this slot the cleansing liquor is removed by an abstractor having a narrow inlet slot which engages the low face of the fabric. Hot air is blown in at the top of the dome and through the fabric as it passes over the slot in the table, the air pressure being such that only slight downwards bellying of the fabric is caused. C. O. C.

Web-winding Machines. John Waldron Corpn. *BP* 666,317

Heating Travelling Webs. Selas Corpn. of America. *BP* 667,117
A machine in which the web may be moved into or out of the heating chamber, e.g. a drying oven or singeing machine, without altering the tension in it. C. O. C.

Continuous Heating of Open-width Cloth to effect Treatments consisting of at least Two Different Stages. J. Dungler. *BP* 667,210
Fabric impregnated with e.g. an aqueous precondensate of a resin is passed through a chamber, where it is treated with successive high-speed jets of a superheated vapour, the speed, rate of flow, and temperature of these jets being such that evaporation of the solvent, and the reaction temperature of the agent contained in it, are maintained simultaneously both on and in the fabric. C. O. C.

Combined Clip and Pin Stenter Chain. P. Deck. *BP* 666,441

Coating an Adhesive Backing with Flock or Pile-forming Fibres. Behr-Manning Corpn. *USP* 2,563,259
Apparatus which deposits the fibres by electrostatic forces so that they are oriented normal to the backing surface is described. C. O. C.

Web-coating Apparatus. Columbia Ribbon & Carbon Manufacturing Co. *USP* 2,565,319
A machine especially suitable for applying wax-base transfer inks is described. C. O. C.

Coating or Impregnating Web. American Re-enforced Paper Co. *BP* 667,277
The treating liquor is applied uniformly in limited quantities by simple and cheap equipment. It is especially suitable for applying the adhesive when making non-woven fabrics from carded laps or the like. C. O. C.

Silk Screen Stencil Apparatus. Continental Decalcomania Co. *USP* 2,566,919
A stencil and a frame are described whereby the stencil may be quickly and easily mounted on or removed from the frame. C. O. C.

Hardening Felt Hat Bodies. Merrimac Hat Corpn. *USP* 2,566,286
The bodies are hardened while supported in their natural shape, folds and creases being avoided by directing a stream of air between the hat body and its support. This enables the machine to be fully automatic as well as to produce smoother and more uniform hardening. C. O. C.

Laundry Washing Machines. Baker Perkins. *BP* 666,672
A drum-type machine of improved design is described. C. O. C.

Hydroextractors for Laundries and Dry Cleaners. J. P. Spencer. *BP* 667,456

Pad for Steam Press. A. Weber. *BP* 667,438

Feeding and Spreading Device for Ironing Machines. J. H. Taylor. *BP* 666,819

Removing Moisture from the Padding of Rollers in Ironing Machines. Baker Perkins. *BP* 667,178
Infrared lamps are placed so that the padding dries as the machine runs. C. O. C.

Automatic Folding of Bedsheets, etc. D. Foxwell. *BP* 666,764

Laundry Folding Machines. Isaac Braithwaite & Son Engineers. *BP* 667,191

Back-sizing of Rugs after Washing and before Drying. G. R. Moore and A. F. Moore. *USP* 2,563,544

Applying Transfers to Ceramics. British United Shoe Machinery Co. *BP* 667,265
A machine which applies the transfer by compressed air. C. O. C.

New Products (IV p. 187).

III—CHEMICALS; AUXILIARY PRODUCTS; FINISHING MATERIALS

Recent Developments in Academic Fields of Starch Chemistry. E. J. Bourne. *Chem. and Ind.*, 1047–1052 (1 Dec. 1951); 216 (8 March 1952).
A survey of recent starch chemistry, with 162 references. J. W. B.

PATENTS

Textile Oils. Standard Oil Development Co. *USP* 2,565,403
Addition to mineral oils of 18–25% of sodium sulphonate concentrate (65 parts mahogany sulphonate in 35 parts mineral oil) and 0·5–1·5% of the polyoxyethylene derivative of sorbitan mono-oleate does not greatly increase the viscosity, and the oils can then be readily removed from fibres during normal scouring. C. O. C.

Partial Esters of Sulphides of Polybasic Carboxylic Acids—Textile Assistants. Ciba. *BP* 667,384

The products obtained by treating an aliphatic mercapto-carboxylic acid with an ester of an unsatd. aliphatic carboxylic acid containing in at least one ester group the residue of a *cyclo*aliphatic alcohol or an aliphatic hydroxy compound containing a chain of > 5 C are used as textile assistants. Those containing chains of 6–10 C have good wetting properties, while those having chains of 16–18 C are softening agents. C. O. C.

Surface-active Agents. T. Goldschmidt. *BP* 667,049

Surface-active agents with good washing, wetting, and foaming action are prepared by condensing 2-mercapto-arylenethiazolesulphonic or 2-mercaptoarylenethiazole-carboxylic acids in neutral or weakly alkaline solution, if desired with addition of suitable solvents, with aliphatic or aralkyl halogen compounds, the aliphatic hydrocarbon chains of which contain > 4 C atoms, or with hydro-aromatic halogen compounds having > 4 C atoms in their ring or rings. Thus disodium 2-mercaptobenzothiazole-6-sulphonate (150 parts by wt.) is dissolved in 70–80% aq. alcohol (600–800), and gradually mixed, with gentle boiling, with 1-chloro-octane (80). When condensation is complete, excess solvent is removed and residual solution evaporated to give an almost theoretical yield of a white detergent powder. J. W. B.

Surface-active Agents. Sharples Chemicals. *USP* 2,565,986

Compounds of formula $R\text{-}S\text{-}[CH_2CH_2O]_n\text{-}H$ (R = *tert.* Alk of 8–24 C; *n* = 2–28) are very effective surface-active agents for use in washing, wetting, and emulsifying compositions. C. O. C.

Wetting and Detergent Composition. American Cyanamid Co. *USP* 2,562,154–6

Water-soluble Li, Mg, Be, or Co salts are excellent solubilising agents for the higher monoalkyl sulpho-succinates. Addition of these salts enables 1–30% aq. soln. of these succinates to remain stable even in presence of Na or K salts. C. O. C.

Detergents. D. G. Kerr. *BP* 666,496

Mixing an ammonium carbonate and an alkali-metal salt of a long-chain paraffin sulphonic acid and/or an alkali-metal acid sulphate of a long-chain aliphatic alcohol gives improved removal of dirt from cellulosic fibres and less hardening of the handle of wool. C. O. C.

Alkarylsulphonate–Carboxymethyl Cellulose Alkaline Salt Detergent. Wyandotte Chemicals Corpn. *USP* 2,566,501

A mixture of 40–90% sodium "keryl"-benzene-sulphonate (alkyl group averages 12 C and is derived from a petroleum distillate of boiling range 150–300° C.), 10–60% sodium carboxymethyl cellulose, and up to 50% inorganic alkaline salt has equal or greater detergency value for washing cotton than have soap-based compositions. C. O. C.

Polyethylenepolyamine Acid Compounds—Sequestering Agents for Multivalent Metallic Salts and Compounds. F. C. Bersworth. *USP* 2,564,092

Polyethylenepolyamine acids, e.g. triethylenetetra-aminetetra-acetic acid, are effective sequestering agents for metallic salts and compounds in alkaline solution, forming non-ionic complexes therewith which are stable in presence of precipitants for the sequestered ion. C. O. C.

Lanolin Alcoholysis Products. Atlas Powder Co. *BP* 666,972

Lanolin is heated with a polyoxyethylene ether of an aliphatic polyhydric alcohol in presence of an alcoholysis catalyst to give a product, containing substantial proportions of wool-wax alcohols, which can be used in forming stable oil-in-water emulsions. Thus lanolin (850 g.) and mixed polyoxyethylene ether (650) formed from ethylene oxide (880) and 85% aq. sorbitol (182) are made to react in presence of 3 c.c. NaOH (500 g./litre) at 275° C. for 240 min. in an atmosphere of CO_2. Activated carbon (30) is added, and the mixture agitated while cooling to 175° C. and filtered. The product is similar to lanolin and also readily water-dispersible. J. W. B.

Starch. American Cyanamid Co. *USP* 2,566,842

Improved fluidity, stability, and adhesion are imparted to starch sizes if a small amount of a lower alkyl- or low hydroxyalkyl-substituted dicyandiamide is added.

USP 2,566,861

A water-soluble salt of dicyanhamide is used.

USP 2,566,862

A water-soluble salt of dicyanoguanidine is used. C. O. C.

Size. DuP. *USP* 2,566,149

A size, soluble to at least a 10% aq. soln. at 100° C., consists of polymethacrylic acid mixed with 0·3–12·0% of its weight of the polymethacrylate of ammonia, an organic base, or an alkali metal and 0·01–5·0% of a wetting agent. C. O. C.

Aqueous Sizes for Nylon. Sun Chemical Corpn. *USP* 2,565,962

Solubilised casein and a polyvinyl alcohol yield a size especially suitable for nylon to be knitted into hose. C. O. C.

Wax Emulsions. Universal Emulsifiers and Peter Spence & Sons. *BP* 666,617

Stable aqueous emulsions of wax which do not tend to cream or form a hard crust on top are produced by emulsifying the wax in water in presence of gelatinous alumina (0·3–2·0 parts by weight of Al_2O_3 per 100 parts emulsion) and then adding a water-soluble Al salt of a monobasic acid (0·005–0·2% by weight) and vigorously stirring. C. O. C.

Laundry Starch. S. C. Johnson & Son. *USP* 2,563,661

An aqueous composition for imparting a stain-resistant, water-repellent, and starchy finish to laundered fabrics comprises wax, a water-soluble salt of a multivalent metal, a protective colloid, and cooked and raw starch. The starch makes up 50–98% of the total solids, the raw : cooked starch ratio being not < 3 : 1. *USP* 2,565,686

The starch used is all raw. C. O. C.

Formaldehyde–Urea Condensation. Monsanto. *USP* 2,561,973

A monomeric urea–formaldehyde condensate having excellent low- and high-temperature stability and curing rapidly when heated in presence of a latent curing catalyst is produced by adding urea (1 mol.) to formalin (1·4–2·0 mol. HCHO) at room temperature. The mixture is then brought to pH 7·8–8·3 by adding an aliphatic or alicyclic amine of 2–6 C and Na_2CO_3, NaOH, or Na borate, the ratio by weight of amine to Na compound being 2–50 : 1. The mixture is kept at < 90° F. for not < 1 hr. and then at < 150° F., preferably < 100° F., until the reaction mass contains < 2·5% free HCHO. The product is suitable for preparing shrink- and/or crease-resistant textiles. C. O. C.

Water-soluble Urea–Formaldehyde Resins modified with Substituted Amino Compounds. American Cyanamid Co. *USP* 2,565,278

Products suitable for imparting wet strength to paper and for treating leather and textiles are produced by condensing urea with formaldehyde and an aminopyridine, the latter being either present in the initial mixture or added after the first two components have been condensed together; in either case initial condensation is effected at 70–85° C. and pH 7·5–9·5. Subsequently the pH is brought to 1–6·5, and the temperature to 25–100° C. C. O. C.

Stabilised High-solids Melamine–Formaldehyde Resin Solutions. American Cyanamid Co. *USP* 2,564,925

Addition of 5–50% by weight of urea stabilises acid solutions containing 12–40% by weight of melamine–formaldehyde resin. C. O. C.

Chlorinated Carbohydrate Esters and Ethers. Sharples Chemicals. *USP* 2,562,883–4

The products obtained by immersing carbohydrate esters or ethers, e.g. cellulose or starch acetate or methyl cellulose, in liquid chlorine have affinity for cellulose, to which they impart waterproof properties. They are useful in film-forming compositions for coating or sizing paper, for waterproofing textiles, etc. C. O. C.

Copolymers of Vinyl Chloride, Allyl Glycidyl Ether, and Allyl Esters of Hydroxyalkanoic Acids. DuP. *USP* 2,562,897

Copolymers of vinyl chloride (70–85%), allyl glycidyl ether (4–28%), and an allyl ester of a mono(primary) hydroxyalkanoic acid of 2–6 C (2–26%) on being baked

yield a heat- and print-resistant film. They are used for coating and impregnating textiles, paper, etc. C. O. C.

Arylmethyl Carbonates — Flame-resistant and Water-repellent Agents. Ohio-Apex. *BP* 666,560

Compounds of formula $CO(O\text{-}CH_2\text{-}Ar)_2$ (Ar may be substd.) are obtained by treating an arylmethyl chloride with Na_2CO_3 or $NaHCO_3$ in presence of a catalyst. They are insensitive to water and compatible with natural and synthetic resins. They can be used in rendering textiles flame-resistant and water-repellent. C. O. C.

Film-forming Latex of Unplasticised Ternary Vinylidene Chloride Copolymers. Dow Chemical Co. *BP* 667,392

The dispersions obtained by polymerising together vinylidene chloride (89–92), acrylonitrile (2–4), and ethyl acrylate (to make up to 100) in water (45–60 monomers : 55–40 water) in presence of an anionic emulsifier and a peroxide catalyst at pH 1·5–6·5 deposit flexible and elastic films which are continuous and very impervious to moisture when dried at room temperature. C. O. C.

Water-repellent Compositions containing Wax and Polymeric Polyamines or Ketones. Du Pont. *USP* 2,566,237

Textiles are made water-repellent if impregnated with a blend of a wax and a polymeric amine obtained by reducing a polymer containing a number of C·N or C:N linkages, any remaining valencies of the N atom being satisfied solely by doubly bonded O, and the polyamine having a main chain consisting solely of C atoms with the amino groups attached to the main chain solely through hydrocarbon radicals laterally substituted thereon, e.g. a polyacrylonitrile.

USP 2,566,272

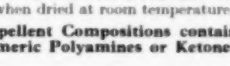
A mixture of a water-repellent wax, a polymeric ketone, and a primary or secondary amine is used. C. O. C.

Thixotropic Emulsions. Sharp & Dohme. *BP* 667,742

A thixotropic emulsion is obtained from an aqueous dispersion of a water-insoluble alkaline-earth metal salt and an oil or resin by adding citric acid or a water-soluble citrate. C. O. C.

Phenyl Diamidothiophosphates — Fungicides and Insecticides. Dow Chemical Co. *BP* 666,928

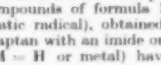
Compounds of formula—



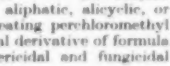
(one of R^1, R^2, R^3, and R^4 = Alk or *cyclo*alkyl and the others = H, Alk, or *cyclo*alkyl; one X = NO_2 and the other = H) are effective fungicides and insecticides. C. O. C.

***N*-Trichloromethylthioimides — Rotproofing Agents.** Standard Oil Development Co. *BP* 666,636

Compounds of formula I (R = aliphatic, alicyclic, or aromatic radical), obtained by treating perchloromethyl mercaptan with an imide or a metal derivative of formula II (M = H or metal) have bactericidal and fungicidal properties.



(I)



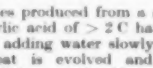
(II)

C. O. C.

Alkyl*cyclo*hexylmethylpyridines — Fungicides. F. E. Cislak. *USP* 2,564,249

Reilly Tar & Chemical Corpn. *BP* 666,730

Compounds of formula—



are exceedingly effective fungicides. C. O. C.

Silicon Acylates. Montclair Research Corpn. and Ellis-Foster Co. *USP* 2,566,347

Silicon acylates produced from a silicon halide and an organic carboxylic acid of > 2 C have a wide variety of uses. Thus by adding water slowly to the tetra-acylate considerable heat is evolved and hydrated silica is deposited; but if the water is added rapidly, although heat is generated, no precipitate forms, a colloidal solution of silica resulting. This colloidal solution can be used for impregnating cloth or paper. C. O. C.

Organosilicon Polymers — Hydrophobing Agents. Dow Corning. *BP* 667,435

Compounds of formula $[\text{-}CH_2\text{-}SiR_2\text{-}]_n$ (R = Alk or monocyclic Ar; n = 3–50) are thermally more stable than siloxanes. The Si-C-Si bonds are not broken by acids and alkalis under ordinary conditions. C. O. C.

Foam-inhibiting Composition. General Aniline. *BP* 667,649

A water-soluble powder mixed with a gelatinous-to-viscous liquid siloxane polymer has excellent foam-inhibiting power when added to aqueous solutions. C. O. C.

Resin-coated Glass Fibres. Owens-Corning Fiberglas Corpn. *USP* 2,563,289

Resinous polymers containing the group $>NR^1R^2X$ (R^1 and R^2 = H, Alk, Ar, aralkyl, or heterocyclic radicals; X = a highly ionisable anion; the resinous component attaches to at least one of the free valencies), e.g. polymer of *o*-vinylpyridine, have very good adhesion to glass, the bond being maintained even in presence of water. C. O. C.

Methylal as Solvent for Vinyl Polymers. Celanese Corpn. of America. *USP* 2,561,513

Methylal is an excellent solvent for vinyl polymers, except those containing halogen, on which it has no solvent action. C. O. C.

Driers. R. T. Vanderbilt Co. *USP* 2,565,897

A mixture of a manganese drier and *o*-phenanthroline, *o*-phenanthroline monohydrate, or *αα*-dipyridyl (0·5–10·0 parts by weight to 1 part Mn metal) is an excellent drier for use in paints, printing inks, etc. C. O. C.

Foam-inhibiting Agent for Pulp and Paper Stock. Nopco Chemical Co. *USP* 2,563,856

An aqueous emulsion containing mineral wax (10–20 parts by wt.), Na or K ricinoleate (4–7), a monoester of a polyhydric alcohol and a fatty acid of 16–22 C (5–20), and water (not > 99% of the emulsion) is an effective foam inhibitor and destroyer.

USP 2,563,857

The emulsion contains not > 99% by weight of water and mineral wax (10–20), Na or K salt of a fatty acid of 16–22 C (4–7), a monoester of a polyhydric alcohol and a fatty acid of 16–22 C (5–20), and an ester of a monohydric alcohol of 1–10 C with a fatty acid of 16–22 C (5–15). C. O. C.

New Products (IV below).

I.G. Farbenindustrie A.-G., Hoechst a.M.— Intermediates, Dyes, and Textile Chemicals; Reflectometer (IV below).

IV—RAW MATERIALS; INTERMEDIATES; COLOURING MATTERS

New Products. *Amer. Dyestuff Rep.*, **40**, 789–922 (10 Dec. 1951).

An alphabetical list of new dyes, pigments, auxiliaries, machinery, machine accessories, and testing apparatus developed between Nov. 1950 and Dec. 1951. J. W. B.

I.G. Farbenindustrie A.-G., Hoechst a.M.— Intermediates, Dyes, and Textile Chemicals; Reflectometer. FD 535/51*.

An alphabetical index to 95 reports written in 1934–46 and contained in 16 microfilms. They deal mainly with the manufacture of intermediates, dyes, pigments, and textile assistants, but include a few on inorganic compounds and one on a reflectometer for use in measuring the reflectance values of washed cloths. C. O. C.

* Available from T.I.D.C., D.S.I.R., Cunard Building, 15 Regent Street, London S.W.1.

Solubility of Aniline Hydrochloride in Water. E. H. House and J. H. Wolfenden. *J. Amer. Chem. Soc.*, **74**, 562–563 (20 Jan. 1952).

The values given in the literature for solubility at 25°c. agree, but those for solubility at 15°c. are at variance with common observation of the salt in its purification by

recrystallisation. Solubility to within 0·7% at 0–50°C. and 2·5% at 50–100°C. is given by the equation—

$$\log N = 1{\cdot}344 - \frac{665}{T}$$

(N = mole fraction; T = absolute temperature).
C. O. C.

Sodium Perborate as a Reagent in Organic Chemistry. I—Preparation of Azo Compounds. S. M. Mehta and M. V. Vakilwala. *J. Amer. Chem. Soc.*, **74**, 563–564 (20 Jan. 1952).

Oxidation of aniline and some of its *p*-subst. products with Na perborate,dissolved in glacial acetic acid yields the corresponding azo compounds in relatively pure form and, except for aniline and *p*-anisidine, free from tarry by-products. With aq. acetic acid yields are less. The products cannot be recovered by direct crystallisation but must be steam distilled. Usually the Na perborate–acetic acid reagent produces higher yields than equivalent H_2O_2–acetic acid mixtures, but addition of boric acid, equivalent to that in sodium perborate, improves the yield of oxidation products obtained by use of the latter mixture.
C. O. C.

Dichroism of Benzene Rings. I—Dichroism of Hexamethylbenzene and Hexabromomethylbenzene. II—Dichroism of *m*-Dinitrobenzene and Anthraquinone. K. Nakamoto. *J. Amer. Chem. Soc.*, **74**, 390–393 (20 Jan. 1952).

I—Hexamethylbenzene and hexabromomethylbenzene, whose crystal structures had been shown by X-ray analysis to be perfect, showed remarkable dichroism measured by the microscopic method. In both cases absorption of polarised light whose electric vector vibrates parallel to the benzene ring was always more bathochromic and hyperchromic than absorption of light polarised perpendicularly to the plane of the ring.

II—The above is also true of *m*-dinitrobenzene and anthraquinone, and is a general rule supported by electronic theory.
C. O. C.

Free-radical Aromatic Substitution. I—Reaction of Benzoyl Peroxide with Naphthalene Derivatives. R. L. Dannley and M. Gippin. *J. Amer. Chem. Soc.*, **74**, 332–334 (20 Jan. 1952).

Thermal decomposition of benzoyl peroxide in 1-chloro-, 1-bromo-, and 1-nitro-naphthalene results in mono-substitution by a benzoyloxy group in the 2-, 4-, or 5-position of the naphthalene derivative. Ratios of yields of homonuclear to heteronuclear substitution products indicate that the substituents activate attack by the benzoyloxy radical in the following order $NO_2 > Br > Cl > H$.
C. O. C.

Molecular Compounds and their Spectra—II. R. S. Mulliken. *J. Amer. Chem. Soc.*, **74**, 811–824 (5 Feb. 1952).

A simple general quantum-mechanical theory, which puts into more accurate form ideas in frequent use for some time, is given for the interaction of electron acceptors and donors to form 1 : 1 or *n* : 1 molecular compounds ranging from loose complexes to stable compounds.
C. O. C.

Relationship between Absorption and Emission of Alcoholic Solutions of Acridine Orange NO. P. Szász. *Acta Univ. Szeged, Chem. et Phys.*, **2**, 249–255 (1950): *Chem. Abs.*, **46**, 350 (25 Jan. 1952).

Ethyl alcoholic solutions of 66, 132, and 331 mg. Acridine Orange NO per litre gave in neutral medium absorption maxima at 448, 473, and 500 mμ, for bands I, II, and III respectively; corresponding k values were 1·2, 0·75, and 0·91. When the dye solution contained 0·0001–1·0 N-HCl and 0·132 g. dye per litre, the maximum values of band I decreased with increasing HCl concentration, whereas the maxima of bands II and III increased. With 1·6 mol. of HCl to each mol. of dye absorption values scarcely varied. This seems to prove that, if there are 1–2 mol. of HCl for each mol. of dye, then tautomer A exists to a dominating extent and further mol. of HCl have no effect on absorption, or on the equilibrium between the tautomeric dyes. When NaOH (up to 10^{-4}–10^{-3} N.) was added to the solution containing 0·132 g. dye per litre, band I was predominant. When the absorption bands between 440 and 430 mμ were observed in alkaline medium, divergence was found between analytical data and actually measured values. The same difference was noted in neutral soln., but not in acid soln. This seems to show that on adding alkali a new maximum develops at the boundary of the ultraviolet and visible spectrum. Comparison of the emission bands in neutral, acid, and alkaline solutions showed that fluorescence emission is caused by one of the tautomeric forms.
C. O. C.

Influence of Solvents on the Colour of *p*-Dimethylaminobenzaldehyde Phenylhydrazone. R. Cuusa and W. Cuusa. *Gazz. Chim. ital.*, **81**, 262–265 (1951): *Chem. Abs.*, **46**, 461 (25 Jan. 1952).

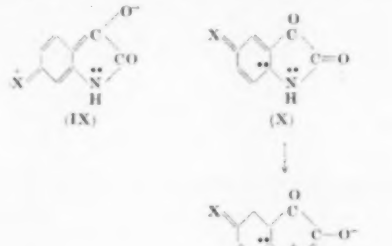
p-Dimethylaminobenzaldehyde phenylhydrazone yields red crystals from $CHCl_3$ and green crystals from C_6H_6. Observation of the absorption maximum λ_1 in the visible spectrum in various solvents showed that, depending on the dielectric constant ε of the solvent, λ_1 shifts from 400 to 450 mμ., whereas the absorption maximum λ_2 in the ultraviolet remains constant between 305 and 310 mμ. Soln. in solvents of low ε show λ_1 toward the blue, in solvents of high ε toward the red end of the spectrum. This agrees with the fact that prevalently green crystals are obtained in low-ε solvents but prevalently red crystals in high-ε solvents, C_6H_6 and $CHCl_3$ being the extremes. The relation between λ_1 and ε suggests a polarising effect of the solvent on the R^1-CH:N-NH-R^2 system.
C. O. C.

Mesomerism and Colour. V—Coloured Compounds: the Organic Chemist's Point of View. A. van Dormael and A. de Cat. *Ind. chim. belge*, **15**, 311–327 (1950); **16**, 7–13 (1951): *Chem. Abs.*, **46**, 412 (25 Jan. 1952).

A review in which the effect of the length of the conjugated chain, relation of symmetrical to asymmetrical structures, rôle of energetic asymmetry, di- and tri-phenylmethane dyes, and the hypsochromic effect, substitution in the conjugated chain, and replacement of CH by N are discussed.
C. O. C.

Absorption Spectra in the Isatin Series. A. Mangini and R. Passerini. *Boll. sci. Facoltà Chim. ind. Bologna*, **9**, 51–52 (1951): *Chem. Abs.*, **46**, 350–351 (25 Jan. 1952).

Absorption maxima and log ε of isatin (I), 4- (II), 5- (III), 6- (IV), and 7-methylisatin, 4- (V), 5- (VI), 6- (VII), and 7-chloroisatin, 5-, 6- (VIII), and 7-methoxyisatin, and the *N*-acyl derivatives of I–VIII in conc. H_2SO_4 (1 : 100,000) are given. Isatin and its derivatives show three absorption bands at 242–261 mμ. (A), log ε 4·20; 298–320 mμ. (B), log ε 3·5–3·7 (VIII, log ε 4); and above 400 mμ. (C). Band A is attributed to excitation of the benzene ring; band B to C:O and the conjugation of the substituent in the 6-position according to formula IX and the similar but small additional effect of the 4-substituent; and band C to –NH·CO– and the 5- and less distinctly the 7-substituent according to X and XI. By substitution the position of A



is not modified, and its log ε generally only slightly modified, whereas B is shifted to higher λ with generally higher log ε; and C tends to disappear except in 5-subst. isatin. The *N*-acetylated isatins show shift of all three bands to lower λ. The absorption curves of isatin and *N*-methylisatin are practically identical. The regularity of the influence of substituents on absorption is also found in the indigo and thioindigo series.
C. O. C.

Self-absorption of Fluorescent Dye Solutions. P. Frohlich and P. Szor. *Acta Univ. Szeged, Chem. et Phys.*, **3**, 16–19 (1950): *Chem. Abs.*, **46**, 350 (25 Jan. 1952).

A method is elaborated by which the emission band which does not contain the self-absorption effect can be calculated on the basis of the emission data. C. O. C.

Synthesis of *m*-Aminostyrene and some Azo Dyes derived from it. K. Urata, H. Senda, and R. Oda. *Chem. High Polymers* (Japan), **7**, 90–94 (1950): *Chem. Abs.*, **46**, 739 (25 Jan. 1952).

Azo dyes from *m*-aminostyrene monomer and low polymers are similar to those derived from aniline but have somewhat better dyeing properties. Dyes from medium polymers are not soluble in water but may be formed *in situ* on the fibre. Those from high polymers may find some use as pigments. C. O. C.

Chemotherapeutic Dyes. I—5-Aralkylamino-9-alkylaminobenzo[a]phenoxazines. M. L. Crossley, P. F. Dreisbach, C. M. Hofmann, and R. P. Parker. *J. Amer. Chem. Soc.*, **74**, 573–578 (5 Feb. 1952).

Chemotherapeutic Dyes. II—5-Arylamino-9-dialkylaminobenzo[a]phenoxazines. M. L. Crossley, R. J. Turner, C. M. Hofmann, P. F. Dreisbach, and R. P. Parker. *J. Amer. Chem. Soc.*, **74**, 578–584 (5 Feb. 1952).

Chemotherapeutic Dyes. III—5-Heterocyclic-amino-9-dialkylaminobenzo[a]phenoxazines. M. L. Crossley, C. M. Hofmann, and P. F. Dreisbach. *J. Amer. Chem. Soc.*, **74**, 584–586 (5 Feb. 1952).

Fifty Years of Indanthren. M. A. Kunz. *Textil-Rund.*, **6**, 533–548 (Dec. 1951); *Melliand Textilber.*, **33**, 58–69 (Jan. 1952).

A historical review of anthraquinone chemistry with special reference to the career and achievements of Bohn. The early introduction of these vat dyes into the textile industry is attributed to Bohn's personal co-operation in dye- and print-works. A critical discussion of views regarding the cause of important fastness properties is included. G. L.

Natural Anthocyanin Pigments. A. L. Maroto. *Rev. real Acad. Cienc. exact, fis. y nat.* (Madrid), **44**, 79–101 (1950): *Chem. Abs.*, **46**, 581 (25 Jan. 1952).

The pigment present in *Crocus sativus* and *Lavendula pedunculata* is believed to be a new anthocyanin, 5-xylopetunidin. C. O. C.

Fungus Pigments. I—Cinnabarine, a Colouring Matter from *Trametes cinnabarin*. J. Gripenberg. *Acta Chem. Scand.*, **5**, 590–595 (1951): *Chem. Abs.*, **46**, 513 (25 Jan. 1952).

A pigment having the probable formula $C_{14}H_{10}O_5N_2$ has been isolated and given preliminary investigation. C. O. C.

Precipitation of Aluminium in presence of Alkanet. F. Burriel and J. R. Muñoz. *Anales real Soc. espaň. Fis. y Quím.*, **45 B**, 1413–1422 (1949): *Chem. Abs.*, **46**, 682 (25 Jan. 1952).

A lake is formed in the interval of pH where $Al(OH)_3$ exists. Colorimetric studies of precipitations at pH 4-5 show that the phenomenon is a typical case of adsorption. C. O. C.

Inhibitory Effect of Xanthopterin upon the Formation of Melanin *in vitro*. S. Isaka. *Nature*, **169**, 74–75 (12 Jan. 1952).

The action of xanthopterin is studied on all three steps in the autoxidation of dihydroxyphenylalanine, and is considered to be inhibitory only on the third stage. J. W. B.

Fabrics and Dyes of Ancient Egypt. G. Serchi and F. Morandi. *Chimica* (Milan), **6**, 355–361 (1951): *Chem. Abs.*, **46**, 742 (25 Jan. 1952).

Linen, coir, and wool have been identified in fabrics in the Egyptian Museum, Florence. Colouring matters present were indigo, carthamus, madder, tannins, and iron oxides. 16 References. C. O. C.

PATENTS

p-Amino-*NN*-dialkylanilines by Catalytic Reduction of the *p*-Nitroso Compounds. Basf. *BP* 667,059

Hydrogen at 10–200 atm. in presence of Raney nickel or Raney copper reduces *p*-nitroso-*NN*-dialkylanilines to the corresponding *p*-amino compounds. A suitable temperature range is 50–200°C., and *NN*-dialkylanilines are useful solvents in which to conduct the reaction. Thus, all parts being by weight, dimethylaniline (242) is dissolved in 5 *N*-H_2SO_4 (950), and a solution of $NaNO_2$ (150) in water (300) is run in, a temperature of 0–6°C. being maintained by additions of ice (ca. 600). More dimethylaniline (242) is added, and the whole is then made alkaline at 40–45°C. with 25% NaOH (440). The organic layer is separated, Raney nickel (25) added, and reduction effected in an autoclave at 100–120°C. with H_2 at 100 atm. for 2 hr., *p*-amino*NN*-dimethylaniline being separated by distillation under reduced pressure. E. S.

Aminoazobenzene, etc. Pfister Chemical Works. *USP* 2,538,431

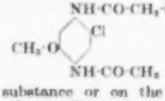
Aminoazobenzene is prepared in good yield by adding a nitrite to aniline and aniline hydrochloride in presence of a monohydric alcohol of < 4 C. The nitrite addition should not take > 45 min., and the temperature should not rise above 40°C. Thus aniline (372 lb.), 96% ethanol (40 gal. (U.S.A.)), and HCl (22° Bé.) (270 lb.) are mixed and cooled to 30°C. Sodium nitrite (140 lb.) is added, while stirring vigorously, over 30–40 min., together with solid CO_2 to maintain a temperature of 30–35°C. An oily product results, and this is drowned in 15% aq. HCl (500 lb.). Aminoazobenzene hydrochloride (450–460 lb.) separates. By starting with o-toluidine, o-anisidine, or o-phenetidine, the corresponding subst. aminoazobenzenes can be prepared similarly. E. S.

Monoazo Chrome Dyes. Ciba. *BP* 666,047

Dyes which may be chromed in substance, or preferably on the fibre, are made by diazotising a 6-acylamino-2-amino-4-nitrophenol and coupling with 2:8-dihydroxynaphthalene-6-sulphonic acid. Depending on the choice and quantity of alkali used in the coupling, greys and olives can be obtained from the same diazo compound, probably because there are two sites available for coupling, viz. the 1- and the 7-positions. Thus, if the coupling 6-acetylamino-2-amino-4-nitrophenol→2:8-dihydroxynaphthalene-6-sulphonic acid is conducted in presence of NaOH, a greenish-olive afterchrome dye is produced. Coupling in presence of $MgCl_2$ and NaOH gives an olive, and in presence of $Ca(OH)_2$ a grey, afterchrome dye. The same dyes may be made by use of 2-amino-4:6-dinitrophenol as the diazo component, followed by reduction of the 6-nitro group with alkali sulphides or hydrosulphides and acetylation of the resulting nitroaminoazo dye. E. S.

Yellow Azoic Dyes. Ciba. *BP* 666,057

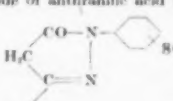
The acetoacetarylide—



coupled in substance or on the fibre with diazotised 5-chloro-2-methoxyaniline or 4-chloro-2-methylaniline gives pure yellows of very good light fastness. E. S.

Yellow Metachrome Monoazo Pyrazolone Dyes. Ciba. *BP* 666,258

Yellow metachrome dyes, containing no sulpho groups, are made by coupling a diazotised 4(or preferably 5)-sulphonamide of anthranilic acid with a pyrazolone—



(R^1 and R^2 = H or hydrocarbon residues; the benzene ring may also contain Alk, Hal, NO_2, or O-Alk). Thus 5-methylsulphamylanthranilic acid is diluted in aq. Na_2CO_3, $NaNO_2$ added, and the solution run into dil. HCl and ice. The diazo compound so formed is run into an alkaline solution of 3-methyl-1-*m*-sulphamylphenyl-5-pyrazolone, to yield a brownish-yellow metachrome dye. E. S.

Chromium-complex Monoazo Dyes. Ciba. *BP* 666,417

Monoazo compounds 2:5-dialkoxyaniline→*ortho*-coupling naphtholsulphonic acid are treated with chromium

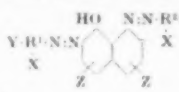
salts under weakly acid conditions, so that the alkyl group *ortho* to the azo link is split off, to give blue wool dyes whose hues are little affected by artificial light. Thus 4-chloro-2,5-dimethoxyaniline is diazotised, and coupled with 1-naphthol-3:6-disulphonic acid in presence of Na_2CO_3, and the resulting monoazo compound treated with $Cr_2(SO_4)_3$ in presence of H_2SO_4 in a lead-lined autoclave at 120–125° C. for 15 hr., to yield a reddish-blue wool dye. E. S.

Chromium-complex Monoazo Dyes. Gy. *BP* 667,168

Water-soluble chromium complexes, which dye wool level from a faintly acid bath, are made by chroming *oo'*-dihydroxy- or *o*-hydroxy-*o'*-carboxy-monoazo compounds containing one or two methylsulphonyl groups but no sulpho groups. Neutral or alkaline chroming methods are preferred, and other *oo'*-disubstituted (e.g. *o*-chloro-*o'*-hydroxy) monoazo compounds, which give rise to *oo'*-dihydroxy or *o*-hydroxy-*o'*-carboxy compounds during chroming, may be used. The products dye also nylon, silk, and leather, especially glacé leather. Thus *p*-chloro-*m*-nitrophenyl methyl sulphone (*BP* 467,549) is boiled with 2 mol. of dil. aq. NaOH, and the resulting *p*-methylsulphonyl-*o*-nitrophenol reduced, e.g. with Na_2S, to the *o*-aminophenol. This is diazotised and coupled with acetoacetanilide in presence of Na_2CO_3, and the monoazo compound converted to the chrome complex by boiling with ammonium chromsalicylate for ca. 30 min. It dyes wool and silk golden yellow from a weakly acid bath. E. S.

Grey, Disazo, Metal-complex Dyes for Leather. Sa. *BP* 666,337

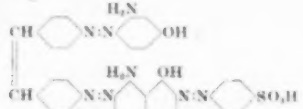
Cr, Fe, and Co complexes of disazo compounds—



(R^1 = a benzene or naphthalene radical; R^2 = a naphthalene radical; X = OH *ortho* to azo; one Y and one Z = SO_3H; the other Y and Z = H or SO_3H) are grey leather dyes. They are made by coupling a diazotised *o*-aminophenol or *o*-aminonaphthol with a 1-amino-8-naphtholsulphonic acid and rediazotising and coupling with a naphthol or naphtholsulphonic acid. Or a 1-acyloxy-8-aminonaphthalenesulphonic acid is diazotised and coupled with a naphthol or naphtholsulphonic acid, the *O*-acyl group is hydrolysed off, and the product coupled with a diazotised *o*-aminophenol or *o*-aminonaphthol. The disazo compounds so formed are metallised by heating with appropriate metal salt solutions. Thus the alkaline-coupled monoazo compound 2-amino-4-nitrophenol-6-sulphonic acid → H acid is diazotised and coupled with 2-naphthol-6-sulphonic acid. The product is heated at 90–95° C. with $CoSO_4$ in presence of sodium acetate to give the grey metalliferous leather dye. E. S.

Black, Trisazo Leather Dye. ICI. *BP* 666,026

The trisazo dye—



gives full blacks of good stability to acids and alkalis on leather of all tannages. It is made by coupling tetrazotised 4:4'-diaminostilbene under acid conditions with 1 mol. of H acid, then coupling under alkaline conditions with 1 mol. of diazotised sulphanilic acid, and finally coupling the diazodisazo compound so formed with *m*-aminophenol under alkaline conditions. E. S.

Black Trisazo Dyes for Leather. Gy. *BP* 667,225

Dyes obtained by the action of 0·8–1·2 mol. of a benzoyl halide, benzoic anhydride, or benzenesulphonyl halide on trisazo compounds—

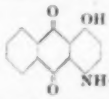
(other common substituents may be present) give good blacks on velours leather, in contrast with the reddish blacks given by such trisazo compounds before acylation. Thus, all parts being by weight, benzidine (18·4) is tetrazotised and coupled with H acid (31·9) under acid conditions. The monoazo compound so formed is coupled with the diazo compound from metanilic acid (17·3) in presence of Na_2CO_3, and the resulting diazodisazo compound is coupled with *m*-toluylenediamine (12·2). At 60° C. benzenesulphonyl chloride (15) and Na_2CO_3 (8) are added, to give the black dye; the position taken up by the benzenesulphonyl group is not known. E. S.

Polyarylmethane Dyes. American Cyanamid Co. *USP* 2,542,544

Rosaniline-type dyes are prepared by oxidising with air or oxygen a leuco diaminodiarylmethane in excess of an arylamine containing reduced sodium metavanadate. Thus fuchsine is obtained by passing air through a suspension of anhydroformaldehyde–aniline and HCl in aniline at 105–110° C. R. K. F.

1-Hydroxy-4-polyfluoroalkylaminoanthraquinones — Dyes for Cellulose Esters. Eastman Kodak Co. *USP* 2,543,767

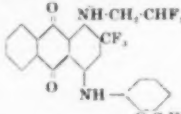
Red-violet dyes for cellulose acetate, fast to gas fumes, are made by condensing a polyfluoroalkylamine with leuco quinizarin. Thus the dye—



is prepared by refluxing leuco quinizarin with $\beta\beta$-difluoropropylamine in *n*-butanol and finally oxidising by adding aq. Na perborate. R. K. F.

4-Arylamino-1-fluoroalkylamino-2-trifluoromethylanthraquinones — Dyes for Cellulose Esters. Eastman Kodak Co. *USP* 2,539,406

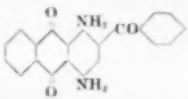
Blue dyes for cellulose acetate fast to light and burnt gas fumes are made by condensing a 4-bromo-1-fluoroalkylamino-2-trifluoromethylanthraquinone with an aminophenyl polyalkoxyalkyl ether. Thus the dye—



is prepared by refluxing 4-bromo-1-$\beta\beta$-difluoroethylamino-2-trifluoromethylanthraquinone with *o*-aminophenyl β-hydroxy-β-ethoxy-β-ethoxyethyl ether, in presence of copper sulphate and potassium acetate, in *n*-amyl alcohol. R. K. F.

1:4-Diamino-2-aroylanthraquinones — Dyes for Cellulose Esters and Superpolyamides. Ciba. *BP* 661,045

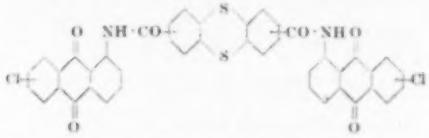
1:4-Diamino-2-aroylanthraquinones in which the 4-amino may be 4-alkylamino with < 3 C atoms are blue dyes for cellulose acetate and nylon. They are made by condensing a 1-amino-2-aroyl-4-halogenoanthraquinone or the corresponding 1:4-dihalogeno compound with ammonia and/or a primary alkylamine, or with an aromatic sulphonamide and then hydrolysing. Thus the dye—



is made by condensing 1-amino-2-benzoyl-4-bromoanthraquinone with *p*-toluenesulphonamide and hydrolysing. R. K. F.

Anthraquinone Thianthrenamides—Vat Dyes. Ciba. *BP* 661,907

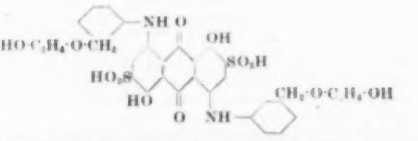
Fast-to-light yellow vat dyes of general formula—



or the oxidised form having a total of < 3 O atoms attached to the S atoms are prepared by condensing a thianthren- or partly oxidised thianthren-dicarboxylic acid or its acid chloride with 1-amino-6(or 7)-chloroanthraquinone. Thus thianthrendicarboxylic acid is heated at 165°c. in trichlorobenzene with $SOCl_2$, 1-amino-6-chloroanthraquinone and pyridine are added, and the whole is refluxed for 15 min. R. K. F.

4 : 8 - Bis - (β - hydroxyethoxy - *m* - toluidino) - 1 : 5 - dihydroxyanthraquinone-2:6-disulphonic Acid—Wool Dye. General Aniline. *USP* 2,539,928

The wool dye—



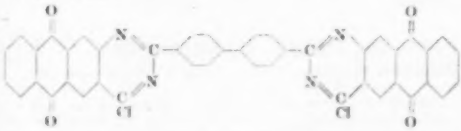
gives on afterchroming a blue-green fast to milling. It is made by condensing 4:8-dibromoanthrarufin-2:6-disulphonic acid with β-*m*-aminobenzyloxyethanol in water at 60–70°c. in presence of Na_2CO_3, Cu_2Cl_2, and finely divided Cu. R. K. F.

Sulphuric Ester of a Leuco Vat Dye. American Cyanamid Co. *USP* 2,540,783

The grey vat dye of *USP* 2,456,589 (*J.S.D.C.*, **66**, 73 (Jan., 1950)), formed by chlorinating benzanthrone, condensing the product with 1-aminoanthraquinone, and alkali-fusing, is converted to a leuco sulphuric ester by one of the conventional methods, e.g. treating with chlorosulphonic acid in pyridine. The resulting dye, unlike most other sulphuric esters, yields prints on cotton which differ in colour from, i.e. are less green than, those produced by the parent dye. R. K. F.

Phthaloylquinazolines (Anthraquinonopyrimidines)—Vat Dyes. Ciba. *BP* 665,510

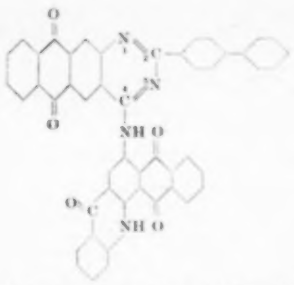
An aminoanthraquinone (2 mol.) containing CN *ortho* to the NH_2 group is condensed with an aromatic dicarboxylic acid (1 mol.). The resulting compound is treated with PCl_5, when the corresponding dichloroquinazoline is formed. This is converted to a green vat dye by condensing with a vattable amine (2 mol.), e.g. 4-aminoanthraquinone-2:1(N)-benzacridone. Thus the quinazoline derivative—



is made by refluxing the condensation product of 2-amino-3-cyanoanthraquinone and diphenyl-4:4′-dicarboxylic acid with PCl_5 in nitrobenzene. It is condensed with 4-aminoanthraquinone-2:1(N)-benzacridone by refluxing in phenol. R. K. F.

Phthaloylquinazoline-Acridone-Anthrimides—Vat Dyes. Ciba. *BP* 661,758

Yellow vat dyes which dye well at 40–50°c. are made by condensing a 4-halogeno-6:7-phthaloylquinazoline, substituted in the 2-position with an aryl residue containing two aromatic 6 C rings, with a 4-aminoanthraquinone-2:1-(N)-acridone. Thus the dye—



is prepared by heating 4 - chloro - 2 - diphenylyl - 6 : 7 - phthaloylquinazoline (from 2-cyano-3-*p*-phenylbenzoylaminoanthraquinone) with 4-aminoanthraquinone-2:1-(N)-acridone in boiling phenol. The product is separated by adding pyridine. R. K. F.

Phthalocyanine Pigments. American Cyanamid Co. *BP* 662,386

Phthalocyanine pigments which do not flocculate when used, e.g. in cellulose nitrate coating compositions, are made by treating a phthalocyanine with an acid in an organic solvent and hydrolysing the resulting "salt" by adding water, an alcohol, or a basic substance. Thus acid-pasted copper phthalocyanine is added to a solution of H_2SO_4 in nitrobenzene and stirred for 10 hr. at 25–30°c. After filtering, the resulting solid is washed with ethanol and water. R. K. F.

Phthalocyanine Pigments—Improving the Non-flocculating Properties. American Cyanamid Co. *USP* 2,540,775

Amorphous phthalocyanine pigments having undesirable flocculating properties, when used in cellulose nitrate lacquers, are improved by treatment in aqueous suspension with a hydrocarbon or halogenated hydrocarbon of b.p. 50–250°c. Thus, copper phthalocyanine is acid-pasted, and the resulting neutral press-cake suspended in water, and stirred at 25–30°c. after adding toluene. When the phthalocyanine has passed to the toluene phase, the solvent is removed by steam distilling. R. K. F.

Grinding of Phthalocyanine Pigments. DuP. *USP* 2,556,726

Chlorine-free phthalocyanine pigments are finely ground by ball-milling in an organic solvent (preferably acetone or a lower alkanol). The products are in the β-form, so that the crystals do not tend to grow in presence of organic solvents, as the α-form crystals resulting from the usual sulphuric acid pasting method do. They are, moreover, greener than pigments produced by acid-pasting. Thus a chlorine-free copper phthalocyanine (45 lb.) in the form of a low-strength pigment containing ca. 75% α-crystals (as determined by X-ray diffraction) together with acetone (225 lb. of 99% purity) was added to a 200-gal. (U.S.A.) ball-mill containing steel balls (3600 lb.) of ca. ¼ in. diameter. The mill was run at ca. 31 r.p.m. for 24 hr., more acetone (225 lb.) being added as the charge thickened. The product consisted entirely of β-crystals, and was greener and more stable towards boiling xylene than the α-form produced by acid-pasting of the same starting material.

USP 2,556,727

Halogenated phthalocyanine pigments are ground to particles of < 0·1 μ. by suspending them in 5–10 times their weight of an organic liquid (preferably acetone) and milling with balls of 0·1–0·25 in. diameter.

USP 2,556,728

Phthalocyanine pigments are ball-milled with salt and 5–50% of a low-boiling chlorinated hydrocarbon to produce the finely divided β-form. Thus the α-form of chlorine-free copper phthalocyanine (75 g.), dry salt (675 g.), and tetrachloroethylene (32 g.) are milled with steel balls of 1 in. diameter for 63 hr. The product consists of β-crystals of length 0·05–0·2 μ.

USP 2,556,729

Metal-free phthalocyanine is ball-milled either with acetone, or with salt and 5–50% of an organic solvent, to

produce the finely divided β-form, which is much greener than the α-form produced by acid-pasting and more stable towards solvents.

USP 2,556,730

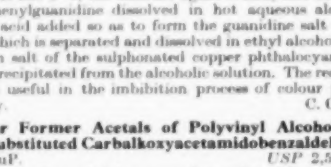
Chlorine-free phthalocyanine pigments are ball-milled with salt in presence of a liquid hydrocarbon of b.p. < 212°C., so that the finely divided β-form is produced. Alkylated benzenes (e.g. xylenes) are particularly useful. E. S.

Sulphonated Copper Phthalocyanine. Kodak.
BP 665,006

Copper phthalocyanine is treated for 2 hr. with excess of 15% oleum at 170–175°C. in presence of mercuric sulphate. The mixture is then cooled, diluted with water, and brought to pH not < 8, acetic acid is added to bring it to pH not > 5, the mixture again cooled, and excess of α-triphenylguanidine dissolved in hot aqueous alcoholic acetic acid added so as to form the guanidine salt of the dye, which is separated and dissolved in ethyl alcohol. The sodium salt of the sulphonated copper phthalocyanine is then precipitated from the alcoholic solution. The resulting dye is useful in the imbibition process of colour photography. C. O. C.

Colour Former Acetals of Polyvinyl Alcohol and Substituted Carbalkoxyacetamidobenzaldehydes. DuP.
USP 2,562,528

Compounds containing recurring units of formula—



(R = Alk of 1–4 C; X = Alk or alkoxy of 1–4 C) are useful colour formers in three-colour photography. C. O. C.

Lakes of Dyes containing a Sulphonic Acid Radical. National Lead Co.
BP 667,765

A dye containing a sulphonic acid radical is mixed in water with a water-insoluble or partly soluble hydrous compound of zirconium, after which a water-soluble zirconium compound is added to precipitate the dye upon the hydrous zirconium compound. Extremely brilliantly coloured products are obtained, which are non-bleeding in water, castor oil, and resins. They are highly opaque and stable to heat and light. As they are insoluble in dilute acids, paints containing them do not tend to liver. C. O. C.

Carbon Black. Phillips Petroleum Co. *USP* 2,564,700

Production of a black as hard as or harder than channel black is described. C. O. C.

Carbon Black. Columbian Carbon Co. *BP* 667,329

A method of modifying the pH and oxygen content of furnace blacks. C. O. C.

Fungicidal Aluminium Leafing Pigment. Reynolds Metals Co. *USP* 2,562,062

A fungicidal pigment paste consists of aluminium leafing flake, a fatty leafing agent, a hydrocarbon thinner, and not < 8% on the foregoing three components of a copper soap containing approx. 8% Cu and 0·2755–4·0% on the weight of the soap of a chlorinated phenol. C. O. C.

Calcium Chromate. M. J. Udy. *BP* 666,466

The reactions and procedures of the ammonia–soda process are used in conjunction with a sodium chromate production procedure to provide a cyclic process for production and recovery of calcium chromate with regeneration of the ammonia–soda process reagents.

BP 666,628

If sodium chromate is used instead of sodium chloride in the ammonia–soda part of the process, then by suitably regulating the procedure anhydrous calcium chromate can be obtained. C. O. C.

Inorganic Maroon. IC. *USP* 2,564,756

A clean bright maroon pigment of particle diameter 0·03–0·5 μ., mean value 0·2–0·3 μ., and approximate composition $K_xCuFe(CN)_y$ is obtained by treating 20–30% aq. $CuSO_4.5H_2O$ at 75–100°C. with 20–30% aq. $K_xFe(CN)_y.3H_2O$ while maintaining excess ferrocyanide in the mixture. C. O. C.

Lead Silicate. Goodlass Wall & Lead Industries.
USP 2,563,367

Hydrated lead silicate useful as a fast-to-light white pigment is made by grinding lead monoxide with silicic acid, preferably freshly precipitated gelatinous silicic acid, in water in presence of an acid catalyst. There must be at least enough silicic acid to convert all the lead into silicate. C. O. C.

Pigments of Improved Texture. Hardman & Holden.
BP 667,192

Dry pigments of improved texture are obtained if a water-soluble salt of an acid of formula C_nH_{2n+1}·COOH (n = 3–29) is added to the aqueous slurry from which they are prepared; e.g. ammonium 2-ethylhexoate is added to freshly made Prussian Blue before filter-pressing. C. O. C.

Dyeing and Printing with Self-coupling Azoic Components (VIII p. 195).

V—PAINTS; ENAMELS; INKS

PATENTS

Fadable Laundry Marking Inks. National Marking Machine Co. *BP* 666,377

A solution of an organic dye or colourless compound which is visible under ultra-violet radiation, of m.p. 0–30°C. above the temperature at which the fabric is to be processed, will withstand one but not two launderings before being entirely removed. C. O. C.

Latices of Rubber and Elastomers as Paint Media. W. Robins. *BP* 666,696

Addition of alkali-metal or ammonium salts of glutamic and glutinic acids to rubber or elastomer latex enables it to be pigmented and to yield a permanent membrane on surfaces coated with it. C. O. C.

Polytetrafluoroethylene Coating Compositions. DuP.
USP 2,562,117–8

Good adhesion is obtained between polytetrafluoroethylene films and non-porous surfaces by using an aqueous solution of the polymer to which has been added chromic acid. If phosphoric acid is used as well as chromic acid, then good adhesion to ferrous metals is obtained after the coating has been fused into a continuous film. C. O. C.

Chlorinated Ethylene Polymer Coating Compositions. DuP. *USP* 2,562,119

Coatings of good adhesion to non-porous surfaces are obtained by use of chlorinated ethylene polymer in aqueous dispersion containing chromic acid. C. O. C.

Coatings for Metals. Cosmocord Plastics. *BP* 661,952

Stoving enamels of phenolic or urea resins show improved adhesion to metals when the condensation of the resin is effected in presence of an alkaline phosphate, e.g. sodium pyrophosphate, which is converted to an acid salt by adding phosphoric acid and, if desired, an acidic metal salt, e.g. sodium dihydrogen phosphate, prior to stoving. E. C.

VI—FIBRES; YARNS; FABRICS

Interfibre Friction. H. G. Howell. *J. Textile Inst.*, **42**, T 521–T 533 (Dec. 1951).

Frictional properties of viscose, cuprammonium and acetate rayons, and nylon are studied by the triangle of forces and inclined plane methods, and the results discussed. Application of results to industrial processes is considered, but the occurrence of frictional high spots, which are avoided during experimental work, is a factor of unknown importance, and a further unknown quantity is the alteration in cohesion which may arise from long storage of elastic polymers. J. W. B.

Load–Elongation Characteristics of Acetate and Viscose Rayons immersed in Water and other Swelling Agents. B. Farrow. *J. Textile Inst.*, **42**, T 534–T 536 (Dec. 1951).

Load–extension curves of acetate and viscose rayons are determined immediately after putting in water and after

4 min.–6 days' immersion. It is found that the initial, relatively inextensible portion of the curve, which is almost eliminated on immediate extension, gradually reappears and after several days becomes nearly half as great as in a dry fibre. The effect is much greater with acetate rayon. The theory is suggested that intermolecular bonds, destroyed during initial immersion, are gradually re-formed in the wet material. J. W. B.

Wetting Characteristics of Cellulose Derivatives. I—Contact Angles formed by Water and by Organic Liquids. F. E. Bartell and H. R. Ray. *J. Amer. Chem. Soc.*, **74**, 778–783 (5 Feb. 1952).

The wetting characteristics of a fairly extensive series of cellulose derivatives were observed by measuring the angle of contact of water and various organic liquids against these derivatives in the form of fibres, foils, rods, films, and coatings. Regular and systematic increase in the hydrophobic nature of the fatty acid esters occurred with increase in length of the hydrocarbon chain; with the acetates, increase occurred with increase in acetyl content. Qualitatively, increase in hydrophobicity with substituent groups was in the order— hydroxyl < formyl < acetyl < hydrogen phthalate < ethoxy < nitro < propionyl < benzoyl. The degree of polymerisation seemed to have little influence on the wetting characteristics of the two sides. Organic liquids of high surface tension tended to give finite angles of contact on the derivatives. Hysteresis of contact angles ranged from approx. 10° to > 40°. Linear relationship was shown when cosines of the contact angles of water on a series of the fatty acid triesters were plotted against either the tensile strengths or the densities of the esters. C. O. C.

Correlation between Initial Young's Modulus and Differential Heat of Sorption at Zero Regain for Cellulosic Fibres. D. R. Ashpole. *Nature*, **169**, 37–38 (5 Jan. 1952).

Differential heats of sorption of cellulosic fibres at zero regain are found to correspond closely with the initial Young's modulus. This is explained by the H bonds in the amorphous region being broken by the water, thus leading to reduction in the strength, which is dependent on the amorphous region. Differential heat of sorption serves to measure H-bond freedom, and is thus connected with fibre strength. Some correspondence is also found between the work of rupture and the total heat of wetting, showing H-bonds to be largely responsible for strength up to breaking point; Sea Island cotton and cellulose acetate are exceptions to this, because of other structures predominating after the initial strain. J. W. B.

Action of Diazomethane on Cotton and various Modified Cotton Celluloses. F. S. H. Head. *J. Textile Inst.*, **43**, T1–T23 (Jan. 1952).

At 0°C. diazomethane methylates cellulose hydroxyl groups very slowly when dry, except with nitrogen dioxide oxycelluloses. Addition of water swells the cellulose and makes OH groups more accessible, enabling a methylated cotton containing nearly one methoxyl group per anhydroglucose unit to be prepared. Esterification of carboxyl groups and methylation of OH groups occur rapidly and simultaneously, dry or wet, in nitrogen dioxide oxycelluloses, which thus show a marked difference from mercerised cotton and periodate oxycelluloses. Reducing power of dichromate and periodate oxycelluloses and of hydrocelluloses is destroyed, owing to reaction with aldehyde groups, which is rapid only in presence of water, and it is probable that ethylene oxide groups are also formed. Nitrogen dioxide celluloses alone show no diminution in alkali-sensitivity. Formation of cyclic semiacetals or semiacetal cross-linkages in periodate oxycelluloses is discussed. J. W. B.

Acid-soluble Lignin. I. R. C. McDonald and W. G. Campbell. *Nature*, **169**, 33 (5 Jan. 1952).

During delignification of wood by sodium chlorite there is formed and retained in the holocellulose residue a modification of lignin which is soluble in sulphuric acid and is thus not determined as a solid residue by the 72% sulphuric acid method. A method has been evolved, but is not described, for using ion-exchange resins to isolate soluble lignin from acid hydrolysates of wood and holocelluloses. J. W. B.

Constitution and Properties of Rayon modified by Sodium Hypochlorite. J. Pinte and P. Rochas. *Teintex*, **16**, 581–609 (Nov. 1951).

The action of NaOCl soln. results in the appearance of aldehydic, ketonic, and acidic groups and also a decrease in mean chain length. Acidic groups are estimated by the Methylene Blue reaction, whilst ketonic groups are differentiated from aldehydic ones by treatment with phenylhydrazine-*p*-sulphonic acid, followed by coupling with the diazonium salt of *o*-dianisidine. Modification of the macromolecular structure of the cellulose occurs, and consequently changes in physicochemical properties are found. Thus the total and diametrical swelling capacity of the treated fibres is decreased, whereas the axial swelling capacity is simultaneously increased. These changes are attributed to the formation of new interchain bonds, e.g. hydrogen bonds, by the carbonyl groups in the more orientated portions of the amorphous regions along the cellulose chains. Tensile strength, sensitivity to alkali, tendency to exhibit yellowing, and alterations in dyeing affinity are correlated with the chemical radicals present in modified cellulose. Aftertreatment of the modified rayon with $NaClO_2$ and/or Na_2CO_3 soln. results in the elimination or transformation of aldehydic and ketonic groups. G. L.

Submicroscopic Structure of Fibres and their Formation. E. Ribi. *Nature*, **168**, 1082–1083 (22 Dec. 1951).

Electron-microscope and electron and X-ray diffraction studies on chitin, polyamide fibres, and polyethylene plastics, and microtome sections of wood, chitinous tissues, and viscose rayon fibres show that the submicroscopic fibril is not specific for cellulose but is a general morphological element which may be formed when linear macromolecules order themselves in a lattice. Theories of orientation during growth are briefly discussed. J. W. B.

Resistant Membrane in Wool. P. Alexander. *Nature*, **168**, 1081–1082 (22 Dec. 1951).

Evidence is summarised for the existence below wool scales of a resistant membrane which is very different from the epicuticle, and which shows the β-diffraction pattern without being heated above room temp., though it is admitted that the process of isolation might effect the $\alpha \rightarrow \beta$ change. It is considered that a separate component contributing about 10% by wt. definitely exists, and this, after breakdown of the 8–8 bonds, resists dissolution even in cuprietylenediamine and conc. LiBr. J. W. B.

Reactions of Keratin in Alkaline Solutions. R. McKay. *J. Soc. Leather Trades Chem.*, **35**, 382–388 (Nov. 1951).

When hair is immersed in lime-water in absence of sodium sulphide, disulphide bonds between adjacent polypeptide chains are hydrolysed—

$$\text{CH·CH}_2\text{·S·S·CH}_2\text{·CH} \rightarrow \text{CH·CH}_2\text{·SOH} + \text{HS·CH}_2\text{·CH}$$

Metallic linkages are then formed, giving the structure—

$$\text{CH·CH}_2\text{·S·O·Ca·S·CH}_2\text{·CH}$$

while at the same time the sulphenic acid groups lose hydrogen sulphide, the aldehyde groups so formed reacting with adjacent amino groups to give—

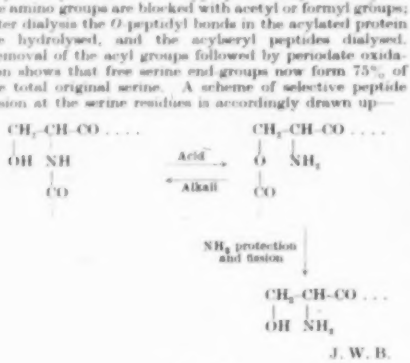
$$\text{CH·CH:N·CH}_2 \ldots \text{CH}$$

groups. Both these linkages are stable to alkalis and reducing agents, which explains why, if a hide is immersed for several hours in lime-water, subsequent addition of sulphide fails to accelerate unhairing. If sodium sulphide is present in the solution initially, sulphenic acid groups will be reduced and neither linkage can be formed. A. S. F.

Selective Fission of the Silk Fibroin Molecule following *N → O* Acyl Migration. D. F. Elliott. *Chem. and Ind.*, 86 (26 Jan. 1952).

A mixture of silk fibroin and conc. H_2SO_4 at room temp. yields after several days a water-sol. product which does

not diffuse through a dialysis membrane, and which contains 9–10% of the total N, falling to 2% on keeping several hr. at pH 9. This is due to *O*-peptidyl → *N*-peptidyl linkage change, reversing that due to the acid. From the two N contents it is estimated that 60% of the hydroxyamino acid residues are involved. By reaction of sulphated protein with the appropriate anhydride at pH 5 the amino groups are blocked with acetyl or formyl groups; after dialysis the *O*-peptidyl bonds in the acylated protein are hydrolysed, and the acylseryl peptides dialysed. Removal of the acyl groups followed by periodate oxidation shows that free serine end-groups now form 75% of the total original serine. A scheme of selective peptide fission at the serine residues is accordingly drawn up—



J. W. B.

PATENTS

Fully Shrunk Rayon Thread. N.V. Onderzoekingsinstituut Research. *BP* 665,114

Fully shrunk viscose or cuprammonium rayon can be obtained by a continuous process by leading the regenerated thread through a drying device in such a way that the thread can sag under its own weight and is always under very little tension during drying. W. G. C.

Acrylonitrile–Vinylpyridine Copolymers. DuP. *BP* 666,716

Fibre-forming polymers, readily dyed by standard commercial techniques with acid and direct cotton dyes of relatively low mol. wt., are obtained by adjusting a mixture of acrylonitrile (98–92) and vinylpyridine (2–8) to pH 4·0–5·9 and heating in the presence of a catalyst, e.g. ammonium persulphate. W. G. C.

Rendering Cyano-containing Polymers more Stable to Heat. DuP. *USP* 2,563,640

Polymers containing a number of nitrile groups attached to the polymer chain, e.g. polyacrylonitrile, on being heated with ammonia and a hydrosulphide, e.g. at 100°C. for 2 hr., are given improved stability to heat and a higher m.p. Yarns or fabrics made from such polymers have improved dimensional stability at high temperatures and retain their excellent dielectric properties.

USP 2,563,662

Mono-, di-, or tri-methylamine is used instead of ammonia. C. O. C.

Polyarylenesiloxane Fibres. DuP. *USP* 2,562,000

Synthetic linear condensation polymers containing siloxane groups, e.g. of formula $[SiR^1_2{\cdot}R^2{\cdot}SiR^1_2]_n$ (R^1 = a univalent organic radical; R^2 = a bivalent organic radical (arylene); $n > 1$) are produced by condensing compounds containing two functional-group-bearing Si atoms which are far enough apart in the molecule for cyclisation through the Si atoms not to occur. Oriented fibres are obtained by melt-spinning them and stretching. C. O. C.

Crimped Composite Yarn. American Viscose Corpn. *BP* 665,172

Yarns which impart a bouclé effect to fabrics woven from them consist of a cellulose ester and a yarn unaffected by aqueous ammonia or alkylenediamines; on treating with these compounds the ester is hydrolysed and shrinks, causing the other yarn to wind itself round the regenerated cellulose component. W. G. C.

Fabrics and Dyes of Ancient Egypt (IV p. 189).

VII—DESIZING; SCOURING; CARBONISING; BLEACHING

Apparatus for the Study of Mechanical Action in Wool Washing. J. C. Dickinson and R. C. Palmer. *J. Textile Inst.*, **42**, T 510–T 520 (Dec. 1951); **43**, T 122 (March 1952).

A plug of oiled wool is firmly clamped between perforated metal discs, which move with controlled velocity through a vertical column of detergent solution at constant temperature. Control and variation of speed are made possible by using a hydraulic ram system for the motive power. Better washing at high speeds is ascribed to the knocking-off of the oil globules whatever the contact angle; with a strong flow a zero contact angle is unnecessary. Increasing plug velocity is accompanied by continuously increasing oil removal. If the plug is immersed in the detergent for different times prior to the rapid "washing stroke" it is found that a 1·5-min. immersion leads to most oil being removed in the stroke; longer immersions give a reduced efficiency. This is ascribed to adsorption of detergent by the wool, thus altering the oil-spreading properties and raising the contact angle.

J. W. B.

Cloth Damage in Crabbing and Steaming. Anon. *Wool Record*, **81**, 810–814 (6 March 1952).

PATENT

Rendering Dry-cleaning Solvents Electrically Conductive. Great Lakes Carbon Corpn. *USP* 2,564,926

Static charge may be continuously dissipated from an earthed cleaning machine by adding to the filtering powder a minute proportion of an alkylated arylsulphonate or an oil-soluble petroleum-sulphonate. C. O. C.

Constitution and Properties of Rayon modified by Sodium Hypochlorite (VI p. 193).

VIII—DYEING

Effect of Light on the Adsorption Equilibrium of Dyes. M. Koizumi and M. Imamura. *J. Chem. Soc. Japan, Pure Chem. Sect.*, **72**, 323–326 (1951): *Chem. Abs.*, **46**, 739 (25 Jan. 1952).

Studies on the effect of light on adsorption of dyes on silica gel from aqueous solutions show that with Rhodamine 6G slight decrease of adsorption was caused. Apparently the excited dye molecules produced by irradiation participated in the adsorption and caused shift of the equilibrium. Two mechanisms are suggested—(1) If the excited dye molecules have a long enough life, two adsorption equilibria are established separately by the dye molecules in the original and in the excited states. The adsorption potential of the latter will differ from that of the former, causing the observed shift. (2) If the light energy absorbed by the dye adsorbed on the solid surface dissipates selectively towards the adsorbent, the temperature of the solid surface may rise locally, or the bond between dye mol. and adsorbent may be excited, causing decrease in amount of adsorbed dye. C. O. C.

Attachment of Dyes to Cotton by Ether Linkage. J. D. Guthrie. *Amer. Dyestuff Rep.*, **41**, P 13–P 14, P 30 (7 Jan. 1952).

Azo dyes are attached to the cellulose of cotton by ether linkages. A number of dyes are prepared by diazotising 2-*p*-aminophenoxyethylsulphuric acid and coupling with a range of phenolic compounds, e.g. naphtholsulphonic acids, to give dyes which are soluble in 20% NaOH, from which they are applied to cotton, etherifying to give excellent wash fastness, and light fastness about equal to that of commercial azoic dyeings. Further ranges can be obtained by reducing with hydrosulphite, rediazotising, and developing with other couplers. J. W. B.

New Developments in the Dyeing of Synthetic Fibres. A. P. Roy. *Amer. Dyestuff Rep.*, **41**, P 35–P 38 (21 Jan. 1952).

Recent improvements in processing new fibres, especially the hydrophobic type, are discussed, and include fast dyeing of nylon at high temp., dyeing of spun and continuous Terylene and Orlon, and acetate rayon dyes at high temp. on Saran. Vicara–wool yarn blends knit better if dyed in package rather than skein form. J. W. B.

Copper Method for Dyeing Orlon Acrylic Fibre. R. H. Blaker and J. F. Laucius. *Amer. Dyestuff Rep.*, **41**, P 39–P 43 (21 Jan. 1952).

Copper salts are studied as assistants in dyeing Orlon, and a satisfactory dyeing procedure is described for polyacrylonitrile fibres in general. Cu^+ ion is formed in the dyebath by reduction of Cu^{++} salts with hydroxylamine sulphate, which avoids precipitation of metallic copper. Cu^+ is adsorbed by the Orlon and forms bonds with certain nitrile groups; dye anion then forms a salt with bound Cu^+, and both adsorption mechanisms can be represented by simple equations. Temperature, pH of bath, and Cu^+ concn. have pronounced effects on the dyeing rate.

J. W. B.

Dyes used by the North American Indians. A. Latour. *Ciba Review*, (90), 3251–3253 (Feb. 1952).

PATENTS

Dyeing and Printing with Self-coupling Azoic Components. F. G. Anderson. *BP* 666,462

Compounds containing two aromatic nuclei, one containing a diazotisable NH_2 group or an NO_2 group convertible to a diazotisable NH_2 group by alkaline reduction, and the other nucleus containing OH capable of directing coupling with a diazo compound, are applied to cellulosic fibres from a vat or sulphur dyebath or in an alkaline discharge printing medium, and the colour is subsequently developed by treatment with HNO_2. Thus the *m*-nitroanilide of 2-hydroxy-3-naphthoic acid is applied to cotton from a sodium sulphide bath, and the fibre is then run into a bath containing $NaNO_2$ and acetic acid, when a red colour develops; a sulphur dye may be applied from the same sodium sulphide bath. E. S.

Dyeing and Printing Cellulose Esters and Ethers. *BP* 665,660

Modification of *BP* 661,800 (*J.S.D.C.*, **68**, 75 (Feb. 1952)). Basic, direct cotton, and mordant dyes which are fast to soaping may replace acid dyes, in which case the dyed or printed material does not need steaming. C. O. C.

Applying Colouring Matters and Textile Assistants to Polymers and Copolymers of Conjugated Dienes which have been treated with Sulphur Dioxide. N.V. De Bataafsche Petroleum M.-S. *BP* 666,644

Conjugated-diene polymers or copolymers of mol. wt. > 5000 which have been treated with sulphur dioxide are swollen and then treated with a colouring matter, e.g. an acid dye, and/or a textile assistant, e.g. a water-repellent or flame-resistant agent. The process is particularly applicable to rubber–sulphur dioxide yarns. C. O. C.

Dyeing Paper with Sulphur Dyes. Ciba. *BP* 661,913

Paper is dyed by adding the water-soluble sulphite or bisulphite derivatives of sulphur dyes to the paper pulp. Thus 10% Pyrogene Deep Black D (*C.I.* 978), made soluble with sodium bisulphite, is added to unbleached sulphite cellulose to which 2% on its weight of rosin size, in the form of a 5% solution, has been added. 9% Aluminium sulphate as a 20% solution is then added, and the resulting pulp passed through the papermaking machine. The resulting black paper is fast to light. R. K. F.

Fifty Years of Indanthren (IV p. 189).

IX—PRINTING

Resin-Copper Complexes in Printing. A. P. Royle. *Amer. Dyestuff Rep.*, **41**, P 15–P 24 (7 Jan. 1952).

Suitable direct dyes are dyed on cotton by either application or discharge printing, and are fixed by after-treating with a resinous copper complex in which copper is incorporated within the resin molecule. A great increase in fastness results, thus leading to a new colour range with washing fastness ranking between that of direct and vat dyes. Processing problems are discussed, particularly with regard to printing clear whites. J. W. B.

PATENTS

Printing with Dispersed Dyes. ICI. *BP* 664,646

Much brighter prints are obtained with dispersed water-insoluble dyes if the printing paste contains a condensate of ricinoleic acid and/or bodied ricinoleic acid with ethylene oxide. C. O. C.

Printing Compositions containing Esters of Leuco Vat Dyes. General Aniline. *USP* 2,540,799

Sulphuric esters of leuco vat dyes, e.g. pyranthrone, which are only sparingly soluble in water, and are therefore difficult to use in printing, are improved in this respect by adding to the printing composition a pyrazolone derivative free from COOH and SO_3H. R. K. F.

Alternate Parallel Coloured and Shrunk Stripe Effects. Heberlein & Co. *BP* 666,925

In the production of alternate parallel coloured and shrunk stripes, moiré effects are avoided if the relationship between the width of the shrunk stripes (*d*), the distance between the shrunk stripes (*c*), the width of the coloured stripes (*a*), and the distance between the coloured stripes (*b*) is, when $d = c$—

$$\frac{c+d}{a+b} = 2k \pm 0{\cdot}2$$

(k = any integer) and when $d \neq c$—

$$\text{then } \frac{d}{c} = \frac{b}{a} \text{ and } \frac{c+d}{a+b} = \frac{n}{2} \pm 0{\cdot}2$$

(n = any odd number > 1). C. O. C.

Multicolour Printing. Eastman Kodak Co. *USP* 2,566,280

Colour-component images are produced on the edge of a pack of metal plates, each component being made on a separate pack. The packs are then split up, and reassembled using a leaf from each pack in succession, thus producing a series of line images. If there are three colour components, then every third line will be part of the same component image. Each set is separately inked, and the sets are placed with their freshly inked edges in a plane and at once contacted with the surface to be printed, upon which there will be imprinted a multicoloured image in the form of fine lines, in the case of three colour components every third line being the same colour. C. O. C.

Protecting Photo-stencils for Storing and or Transport before being placed on the Screen. Davis (Patents). *BP* 667,189

A protective film is applied to the pigmented gelatin stencil while it is still wet from processing. C. O. C.

Silver Azo Dye Bleach-out Process. General Aniline. *USP* 2,564,238

Silver halide emulsions diffusely coloured with an azo dye and containing a silver image may be quickly processed to dye images in absence of a catalyst by using a bleach consisting of a silver salt former, a silver complex former, and an acid. C. O. C.

Direct Positive Photographic Colour Process. Eastman Kodak Co. *USP* 2,566,180

A two-bath procedure is described. C. O. C.

Colour Prints from Colour Negatives using a Negative-integrator Type of Printer. Eastman Kodak Co. *USP* 2,566,277

Making Colour Prints from Colour Negatives. Eastman Kodak Co. *USP* 2,566,264

Diazotype Materials containing Colloidal Silica. General Aniline. *USP* 2,566,709

Incorporation of colloidal silica in the diazotype layer results in the colour-forming components being kept at or near the surface of the layer without any tendency for formation of surface scum. C. O. C.

Recent Developments in Academic Fields of Starch Chemistry (III p. 185).

Dyeing and Printing with Self-coupling Azoic Components (VIII this page).

Dyeing and Printing Cellulose Esters and Ethers (VIII this page).

X—SIZING AND FINISHING

Technology of Urea-Formaldehyde Resin Finishing. J. J. Bernard. *Amer. Dyestuff Rep.*, **40**, P 837–P 842 (10 Dec. 1951).

Problems associated with resin technology in textile finishing are discussed and some methods for resin determination described. J. W. B.

PATENTS

Detection and Marking of Flaws in Woven Fabrics. T. C. Corliss. *BP* 667,021

Woven fabric is passed between a guide roller and a marking roller, which dips into a marking substance or liquid and which transfers some of the marking liquid to any burls, knots, or similar flaws which project from the cloth surface. Such faults are thus made easily visible prior to mending. J. W. B.

Impregnating Cellulose with Sericeous Material. T. C. Whitner. *USP* 2,565,832

Silk is dissolved in an aqueous solution containing a hydroxyalkylamine–copper complex and tetra(hydroxyalkyl)ammonium hydroxide, preferably together with a small quantity of an alkali-metal hydroxide. Cellulose fibres are then impregnated with this solution, treated with acid, and rinsed. C. O. C.

Silicon-containing Cellulosic Derivatives. U. S. Secretary of Agriculture. *USP* 2,562,955

Anhydrous treatment of cellulosic material with a liquid silylating agent in presence of a tertiary heterocyclic amine yields products which are insoluble in cuprammonium solution or in common solvents for cellulose esters or ethers. They are also very hydrophobic, not only because of the blocking of the hydroxyl groups but because of the hydrophobic properties of the alkylsilyl group. C. O. C.

Shrink-resistant Wool Fabrics. DuP. *USP* 2,526,637

Wool fabric can be made shrink-resistant and yet retain its soft handle by treating it with a synthetic high-mol.wt. basic amino polymer and with formaldehyde. The polymer used must have an H atom attached to the amino N atom and must contain 3–50 chain C atoms for each amino group. The treated fabric is finally baked at 20–200°C. to make the amino polymer insoluble. C. O. C.

Rendering Wool Shrink-resistant. M. R. Coe. *USP* 2,562,603

Wool is rendered shrink-resistant by impregnating it with not > 4% by weight of a heat-cured conjugated triolefinic dry oil or its acid so that the film on the fibres is < 0·0001 in. thick. C. O. C.

Imparting Shrink-resistance, Increased Tensile Strength, and a Softer Handle to Protein-containing Textiles. American Cyanamid Co. *USP* 2,565,259

A laundry-fast finish is obtained by treatment with a composition containing by weight 10–100% of a compound of formula $CH_2{:}CH{\cdot}CO{\cdot}O{\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}R$ (R = Alk, aralkyl, Ar, or alkaryl of 9 C), e.g. ethoxyethyl acrylate, and 90–0% of a lower alkyl ester of acrylic acid, e.g. ethyl acrylate, further polymerisation being caused by baking at 200–300°F. C. O. C.

Mothproofing. Merck & Co. *BP* 666,762

Impregnation of wool, etc. with an organic-solvent solution of DDT, and 2–15% (on the weight of the DDT) of a suitable ester, e.g. dibutyl phthalate, tri-*o*-tolyl phosphate, or methyl abietate, yields a mothproof finish which is not liable to bloom. C. O. C.

Stabilising Regenerated Cellulose Fabric with Glyoxal–Amide Reaction Product. Cluett, Peabody & Co. *USP* 2,562,161

The product obtained by treating glyoxal with a compound of formula $R{\cdot}CO{\cdot}NH_2$ (R = H or C_{1-5}Alk) in presence of an acid catalyst imparts dimensional stability to regenerated cellulose fabrics and also resistance to wrinkling, abrasion, crushing, and creasing. C. O. C.

Increasing the Resilience of Yarns and Fabrics containing Acetate Rayon. Celanese Corpn. of America. *BP* 666,368

Yarns and fabrics containing acetate rayon staple of acetyl value 49–57% (combined acetic acid) and saponified acetate staple of acetyl value 42–45% are rendered more resilient by heating and pressing them in presence of moisture, e.g. by calendering the moist yarn or fabric at 150–200°C. C. O. C.

Heating-setting of Thermoplastic Fabrics in Molten Metal. J. Cadgene. *USP* 2,563,394

Thermoplastic fabrics may be heat-set by passing them under the desired warp and weft tension through molten metal at a temperature below that of the m.p. of the fibre. C. O. C.

Lustrous Titanium-impregnated Cellulosic Products. DuP. *USP* 2,563,637

Lustrous products are obtained by impregnating regenerated cellulose or cellulose esters or ethers with a soluble Ti compound, removing the Ti from the surface under non-hydrolysing conditions, e.g. by rinsing in alcohol, and then precipitating a water-insoluble Ti compound within the cellulosic fibres.

USP 2,563,656

The Ti compound on the surface of the fibres is removed by rinsing them with an aq. sulphate, nitrate, or chloride before precipitating the insoluble Ti compound in the fibre. By this means up to 20% Ti by weight can be incorporated in the fibre without any delustring. C. O. C.

Impregnating a Fibrous Sheet with a Phenolic Resin. Westinghouse Electric Corpn. *USP* 2,565,152

Thermosetting phenol–aldehyde precondensates in fibrous sheets form the intermediate resin stage more quickly if the impregnated sheet is treated with steam. C. O. C.

Coated Fabrics for Use in Making Stiffened Laminated Fabrics. Trubenised. *BP* 665,874

The interlayer for a laminated fabric consists of a cloth which has raised points on one or both sides, to which points adhesive has been applied from a smooth roller and then dried. Alternatively the points are depressions in the cloth surface, the raised portions of which are then coated with a resist, so that when adhesive is applied to the fabric it coats only the depressed points. C. O. C.

Improving the Adhesion between Glass Fibres and Resins. Owens-Corning Fiberglas Corpn. *USP* 2,563,288

Improved adhesion is obtained between glass fibres and resins if the fibres are first treated with a solution of a compound of formula $(R^1{\cdot}CH{:}CR^2{\cdot}CH_2)_nSiX_{4-n}$ (R^1 and R^2 = H, Hal, Alk, or Ar; X = Hal, alkoxy, or aryloxy; *n* = 1–3), e.g. diallyldiethoxysilane, and then baked at 250–400°F. C. O. C.

Decoration of Textiles, Paper, and Other Solid Surfaces. H. Freiberg and S. Freiberg. *BP* 666,603

The material to be decorated is covered wholly or in part with an adhesive for the decorative elements, at least the surfaces of which consist of a thermoplastic material; these elements are then applied, and the decorated material is heated to cause permanent adhesion of the decorations to the material and incipient fusion of the surfaces of the decorative elements where they touch one another. C. O. C.

Applying Colouring Matters and Textile Assistants to Polymers and Copolymers of Conjugated Dienes which have been treated with Sulphur Dioxide (VIII p. 195).

XI—PAPER AND OTHER CELLULOSIC PRODUCTS

Decoration of Textiles, Paper, and Other Solid Surfaces (X above).

XII—LEATHER; FURS; OTHER PROTEIN MATERIALS

Reactions of Keratin in Alkaline Solutions (VI p. 193).
Decoration of Textiles, Paper, and Other Solid Surfaces (X above).

XIII—RUBBER; RESINS; PLASTICS

Stabilised High-solids Melamine–Formaldehyde Resin Solutions (III p. 186).

XIV—ANALYSIS; TESTING; APPARATUS

I.G. Farbenindustrie A.-G., Hoechst a.M.—Intermediates, Dyes, and Textile Chemicals; Reflectometer (IV p. 187).
Apparatus for the Study of Mechanical Action in Wool Washing (VII p. 194).
Technology of Urea–Formaldehyde Resin Finishing (X p. 195).

The rubbing fastness of Aridye Pigment Colours has been so improved by the use of the new Anti-Crocking Agent—DR.8020—that these colours can be used with advantage in a still wider range of styles.

For details apply to:—

TENNANTS TEXTILE COLOURS LTD

RAVENHILL ROAD, BELFAST

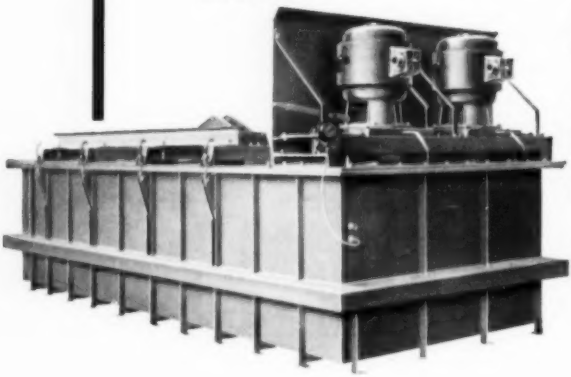
or to their Area Distributors

Aridye Colours and the use thereof are protected by British Patents Nos. 522941, 523090, 524803, 552919, 561641, 561642, 631882.

Hank Dyeing Machine

This outstanding machine for Hank Dyeing incorporates important improvements ensuring efficiency and a higher standard of quality.

- Special C D B Propeller giving large even flow without turbulence.
- Level dyeing without damage to the material.
- Stainless Steel throughout ensures true shades even with the most brilliant colours.
- Constructed to give maximum, efficient life.



Send for Catalogue H 468

Longclose ENGINEERING CO. LTD.

BOWMAN LANE WORKS LEEDS 10 ENGLAND

Telephone Leeds 21978-9

SITUATIONS VACANT AND WANTED, Etc.

Replies may be addressed "Box —, Society of Dyers and Colourists," OCEAN CHAMBERS, 19 PICCADILLY, BRADFORD, YORKS., where all communications relating to these Advertisements, which are treated in strict confidence, should be addressed.

The Publications Committee is prepared to receive Advertisements relating to SITUATIONS VACANT, SITUATIONS WANTED, or MISCELLANEOUS ITEMS for insertion on this page of the Journal. Advertisements of Situations Wanted are gratis to individual members, but must not exceed twenty-four words in length.

All inquiries relating to Advertisements in the Journal should be addressed to the General Secretary, The Society of Dyers and Colourists, OCEAN CHAMBERS, 19 PICCADILLY, BRADFORD, YORKS.

SITUATIONS VACANT

NOTTINGHAM AND DISTRICT TECHNICAL COLLEGE
Principal—H. Baker, Ph.D., A.M.I.C.E., A.M.I.M.E.

APPLICATIONS are invited from GRADUATES in PURE or APPLIED SCIENCE, or from persons holding equivalent qualifications, for the post of LECTURER IN TEXTILE CHEMISTRY AND DYEING. Experience in the Textile Printing or Dyeing Industries will be an advantage, but applications from honours graduates in organic chemistry who are prepared to apply themselves to dyeing problems will be considered.

Salary £900 × 25–1000 p. a.

Application forms and further particulars may be obtained from the Registrar, Nottingham & District Technical College, Shakespeare Street, Nottingham, to whom completed forms must be returned as soon as possible after the publication of this advertisement.

F. STEPHENSON
Clerk to the Joint Education Committee

CHEMIST required to take charge of production of Photo Printing Papers for small manufacturer in Glasgow. Good salary and conditions offered to live man capable of undertaking research. Apply Hamilton, Bale & Co. Ltd., 169 Crownpoint Road, Glasgow, S.E.

YOUNG qualified Chemist with Textile Printing experience required. Good prospects for energetic man with initiative. Commencing salary £800 Box V582

REQUIRED for company in Northern Ireland, Foreman Piece Dyer with experience of Vat, Sulphur and Direct Dyes on Cotton and Cotton/Viscose material. Good salary offered. Apply, giving details of age and experience. Box V665

SITUATIONS WANTED

MEMBER (26), Higher Diploma in Dyeing/Finishing at Nottingham University College, seeks employment as assistant to manager or any progressive position. Work abroad considered. Box W566

WOOL YARN DYEWORKS MANAGER open for engagement. Fully conversant Works Organisation, Layout and Costing, etc. Full knowledge Bleaching, Dyeing, Winding, Make-up and Shrink Resist processing. Box W567

WORKS MANAGER TECHNOLOGIST with wide experience Textile Industry desires position in Managerial capacity. Commercial and Technical Liaison Dyeing Printing and Finishing. Home or Abroad. Box W668

MISCELLANEOUS

WANTED—Copy of bound volume on Symposium on Fibrous Proteins. Box M448

NEW MEMBERS

Persons desirous of joining the Society as Ordinary Members or Junior Members may obtain Application Forms from the General Secretary, or from the Honorary Secretary of any Section of the Society

NEW MEMBERS

Barros, Luiz Oliveira, Rua Honorio de Lima, Porto, Portugal
Holland, J. L., 596 Kings Road, Stretford
Eland, V. E., Churston, 6 Milton Road, Ickenham, Uxbridge, Middlesex
Gobbato, T. A., Rua Goncalo de Carvalho, 45-1° andar, Porto Alegre RGSul, Brazil
Jordan, P. V., 47 Eaton Gardens, West Derby, Liverpool
Nicholls, C. H., 20 Greyshiels Avenue, Headingley, Leeds 6
Olpinski, W., Bruck Mills Ltd., Cowansville, P.Q., Canada
Playle, F. H. C., 25 Bentham Avenue, Woking, Surrey
Priestley, J., c/o Marshall & Fisher Ltd., Awsworth Road, Ilkeston, Derbyshire
Smith, A. H., Cranbourne, St. Andrews Avenue, Morley, Yorks.
Wyatt, A. G., 77 Pollard Lane, Undercliffe, Bradford

READMITTED MEMBER

Lee, W. J. B., Ross Brook, 6 Fairview Road, Timperley, Cheshire

NEW JUNIOR MEMBERS

Mawson, Miss M., 40 Enfield Road West, Baildon, Yorks.
Turrill, E. A., 36 George Road, West Bridgford, Nottingham

Patents — Designs — Trade Marks
W. P. THOMPSON & CO
CHARTERED PATENT AGENTS
60 LINCOLN'S INN FIELDS
LONDON WC 2
Holborn 2174
12 CHURCH STREET
LIVERPOOL 1
Royal 3172

Brilliant Avirols
(ANION ACTIVE FINISHING AGENTS)

●

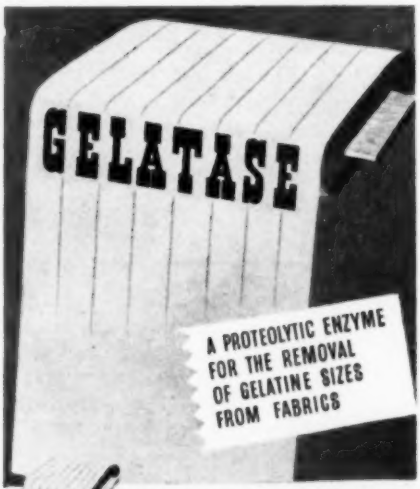
FOR A PERFECT HANDLE
ON SPUN RAYON FABRICS

●

No adverse effect on dyed shades

THE GARDINOL CHEMICAL CO LTD MILNSBRIDGE HUDDERSFIELD
Telephone MILNSBRIDGE 287

Packed in special flexible writing tubes or in tins.
Supplied in Yellow, Black, Red or Blue
For marking all textile piece goods
Successfully withstands Bleaching, Dyeing and Finishing Processes. Dries rapidly and does not "mark-off".
Send for leaflet SY208
GLAZEBROOKS LIMITED
TYSELEY, BIRMINGHAM 11



NEB
NORMAN EVANS & RAIS LTD.
MANCHESTER, 16. TEL: MOSS SIDE 2277/8

SUITING THE PARTICULAR

STAVELEY

Many of the dyestuffs for woollen and mixed-fibre fabrics are derived from the Staveley Chemicals Aniline Oil and Anthracene. Other sections of the Textile Industry processing cotton, linen, rayon and nylon also find these Staveley products together with Staveley Sodium Hypochlorite and Bleaching Powder most satisfactory in their dyehouses.

BASIC CHEMICALS FOR INDUSTRY

CHLORINE · NITROBENZOLE · XYLOL
NAPHTHALENE · SODIUM CHLORATE

THE STAVELEY IRON & CHEMICAL CO LTD near CHESTERFIELD

BRADFORD EDUCATION COMMITTEE

TECHNICAL COLLEGE BRADFORD

DEPARTMENT OF CHEMISTRY AND DYEING

FULL-TIME (DAY) COURSES extending over three or four years and leading to the B.Sc. (Hons.) Degree of the University of London and to the Diploma of the College, are arranged in the following branches of chemical technology—

CHEMISTRY AND DYEING
PURE AND APPLIED CHEMISTRY
DYEING
METALLURGY

Special facilities are available for advanced study and research for M.Sc. and Ph.D. Degrees.

Full Particulars of all courses and Prospectuses may be obtained on application to
THE PRINCIPAL TECHNICAL COLLEGE BRADFORD

STANDARD CLOTHS FOR FASTNESS TESTING

AS RECOMMENDED IN

Second Report of the Fastness Tests Committee

are now available for
Assessing Degree of Staining

Type	*Width*	*Cost per yard*
	in.	*£ s d*
Cotton	33	8 0
Wool	44	1 15 0
Viscose Rayon	37	5 6
Cellulose Acetate Rayon	36	10 0

•

Orders should be addressed to

THE SOCIETY OF DYERS AND COLOURISTS

19 PICCADILLY BRADFORD Yorkshire

DYESTUFFS · ULTRAMARINES

DURA BEAU HOSIERY FINISHES

TEXTILE AUXILIARY PRODUCTS AND FINISHES

T. SAVILLE WHITTLE LTD QUEEN'S CHAMBERS 49 PRINCESS STREET MANCHESTER 2

Telephone Central 5667 (two lines) Telegrams SENILINA MANCHESTER

ROYAL INSTITUTE OF CHEMISTRY

Founded 1877 *Incorporated by Royal Charter 1885*

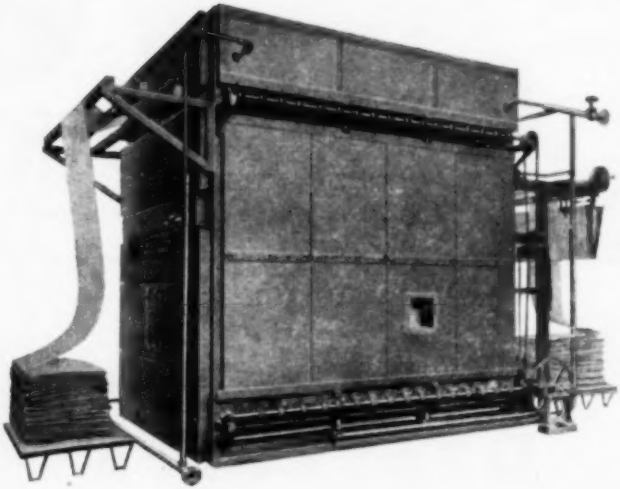
APPOINTMENTS REGISTER

A Register of Chemists (Fellows, Associates, and Senior Registered Students) who are available for appointments, or who are seeking to improve their positions, is kept at the office of the Institute. The facilities afforded by this Register are available (free) to Companies and Organisations requiring the services of Chemists and to Universities, Colleges, and Technical Schools requiring Teachers of Chemistry and Technology.

Particulars of the Regulations and Examinations of the Institute can be obtained (free) on application to
The Registrar, Royal Institute of Chemistry, 30 Russell Square, London WC1

'BAKING' STOVE
for Polymerising

CREASE RESIST, WATER-REPELLANT, PERMANENT GLAZE AND OTHER SYNTHETIC RESIN FINISHES



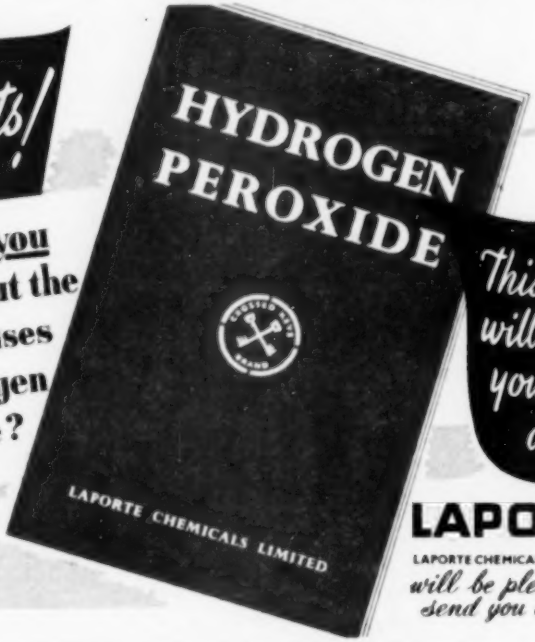
Made by **HUNT & MOSCROP LTD.**

APEX WORKS · MIDDLETON JUNCTION
MANCHESTER · ENGLAND

TELEGRAMS & CABLES 'CENTRAL MIDDLETON' LANCS.
TELEPHONE MIDDLETON 2476-7-8

Chemists!

What do you know about the modern uses of Hydrogen Peroxide?



This Book will bring you up to date

LAPORTE

LAPORTE CHEMICALS LTD., LUTON
will be pleased to send you a copy

ESTABLISHED 1877

We have been Manufacturing

DYESTUFFS

for more than Seventy Years!

Why not avail yourself of our long experience? It is freely at your disposal.

Williams HOUNSLOW Ltd.

HOUNSLOW WH L MIDDLESEX

Aniline & Alizarine Colours

Solvents & Chemicals

We solicit your inquiries for Aniline and Alizarine Colours and Chemicals and shall be pleased to forward samples and prices on application

• HYDROGEN PEROXIDE (CONCENTRATED)

Free from all impurities Prompt deliveries from stock

COLE & WILSON LTD

24 GREENHEAD ROAD HUDDERSFIELD

Telephone Huddersfield 1993 *Telegrams* COLOUR HUDDERSFIELD

WORKS — Common Road Hay Hall Birkby Huddersfield *Telephone* Huddersfield 2499

Textile Assistants

sovatex

sufatol

Sovatex ensures the removal of mineral oil and difficult to clear soiling matter in every fabric cleansing process.

[illegible] to assist in the better processing of textiles.

STANDARD CHEMICAL COMPANY

TELEPHONE: GATLEY 2241 TELEGRAMS: SOVATEX CHEADLE

CHEADLE CHESHIRE

CHAS. FORTH & SON LIMITED

CHEMICALS for Dyers & Bleachers

ACIDS ALKALIES SOAPS

DYESTUFFS for all purposes

DYEWOOD EXTRACTS HEMATINES

Telephones 75147—75148

Code A B C 5th Edition

NEW BASFORD NOTTINGHAM

Telegrams DELTA-NOTTINGHAM

IMPORTERS FROM GERMANY

of

Naphtols Bases Salts
Rapid-Fast-Colours
Rapidogens Rapidazols etc
Stable Solubilized Vat Range
Vat Dyestuffs Pigments etc

AUXILIARIES

FULL PARTICULARS FROM

BERNARD KEEGAN LIMITED

164 GARNETT STREET BRADFORD

Telephone 26717 (3 *lines*) *Telegrams* CHEMDYE BRADFORD

Quality Dyes and Products

L·B·H & Co Ltd

Have YOU *had samples of the recent additions to our ranges of products?*

Monochrome Flavine R
Superlan Astrol B
Paradone Brilliant Orange GR New Double Paste

If not, contact Sales Department—

L B HOLLIDAY & Co LTD HUDDERSFIELD

A Scouring and Fibre Protecting Product for all classes of Textile Fibres. Stable in Baths of all reactions.

MELIORAN

F6

PASTE & POWDER
For Scouring Raw Wool, Tops and Hanks, Crabbing and Level Dyeing, Kier Boiling and Soaping-off Cotton Goods

FX PASTE
A new economical brand of Melioran for all cases of Scouring

CY CONC
For Scouring and Milling Woollen and Worsted Pieces, Scouring and Desizing of Artificial Silk

AGENTS

SCOTLAND—Mr C. Stewart, "Nitsumbi", Bearsden, Dumbartonshire
IRELAND—Alfred Cotter Ltd. 7 Corporation Square, Belfast
AUSTRALIA—Vance & McKee Pty. Ltd. 235 Clarence Street, Sydney
Vance & McKee Pty. Ltd. 40 William Street, Melbourne
NEW ZEALAND—S. W. Peterson & Co. Ltd. 165 Vivian St. Wellington
INDIA—George Wills & Sons Ltd. England
Distributors—Nagindas Kilabhai & Co. Lalgir Chambers, Tamarind Lane, Bombay. Branches—Ahmedabad, Cawnpore, Calcutta, Coimbatore etc

The
HEXORAN CO LTD
Unity Works Belper Derbyshire

Telephone Belper 471
Telegrams PROGRESS BELPER

ARGO *the most up-to-date Dyeing Machines made of best stainless steel*

APPARATE-BAU A.G. ZOFINGEN
SWITZERLAND

ARGO

Agent for Great Britain
CORVIN LTD 246 Ballards Lane LONDON N.12

BROWN & FORTH
LIMITED
FOUNDED 1890

DYESTUFFS

•

SODIUM CHLORITE
AND ALL
CHEMICALS
FOR TEXTILES

83-117 EUSTON ROAD LONDON NW1 EUS 5101-5
118 CHORLTON ROAD MANCHESTER 15 MOS 1347-8
AND AT NEW YORK

TETRALENE
Detergent and solvent for washing and scouring of textile materials, for use with alkaline or soap solutions

ESTRALENE
Sulphonated Fatty Alcohols in Paste Powder and Liquid

ESTROL
Very efficient wetting and dispersing agent

RETARDOL
For level dyeing of vat colours on rayon etc

FURTHER INFORMATION AND LITERATURE ON REQUEST

Manufacturers of
TEXTILE AUXILIARY CHEMICALS

STOCKPORT UNITED CHEMICAL CO LTD
BUXTON ROAD WORKS STOCKPORT
Telephone Great Moor 2980 *Telegrams* TETRALENE STOCKPORT

EDGES
Bleachers Specialities
AS USED IN THE PRINCIPAL BLEACHERIES OF THE WORLD
SHADING BLUES · CLOTH SOFTENERS
CLOTH FILLERS · CLOTH GLAZES
MOVOL — *Stain Remover*
Send for Samples and Prices to Manufacturers
60 YEARS' REPUTATION
Wm EDGE & SONS LTD BOLTON
JN. 614

Telephone Dudley Hill 253 & 254 (Private Branch Exchange) *Telegrams* BISULPHITE BRADFORD
J B WILKINSON (CHEMICALS) LTD
Manufacturers of
SODIUM HYDROSULPHITE POWDER and CHEMICALS
FOR DYERS BLEACHERS PRINTERS and all Branches of the Textile Industry
DUDLEY HILL CHEMICAL WORKS BRADFORD

HATHERNWARE

CHEMICAL STONEWARE

For safely handling ACIDS

BLEACH & DYE

LIQUORS

FUMES etc

In the Laboratory or on full-scale production, wherever corrosive agents are made or handled, Chemical Stoneware and Porcelain ensure freedom from corrosion of Plant or contamination of product. Without obligation, our Technical Department will gladly advise on Plant corrosion problems.

Write for illustrated list

HATHERNWARE LTD
Dept. SD · LOUGHBOROUGH
Telephone **Hathern 273** **England**

COLNE VALE
DYE & CHEMICAL CO. LTD.

MANUFACTURERS OF

BISMARCK BROWN R and Y Conc. and Base	NIGROSINE (Spirit Soluble)	WATER BLUE R Conc
PURE CHRYSOIDINE Y D and R D and Base	NIGROSINE BASE	INK BLUE N and B N
INDULINE (Water Soluble)	BASIC MAGENTA	INK BLUE SPECIAL
INDULINE (Spirit Soluble)	ROSANILINE BASE	SPIRIT BLUE
INDULINE BASE	ACID MAGENTA Conc.	INDIGO CARMINE C V Ex.
NIGROSINE (Water Soluble)	PURE SOL. BLUE 1 Conc.	LAUNDRY BLUES
	PURE SOL. BLUE 3 B Conc.	METACHROME MORDANT
	SOLUBLE BLUE Conc.	

Also full range of ACID, BASIC, DIRECT and CHROME COLOURS
Samples and Prices will be forwarded on application

TELEGRAMS. ANILINE, HUDDERSFIELD. MILNSBRIDGE, HUDDERSFIELD. TELEPHONE 3 MILNSBRIDGE

AMOA CHEMICAL CO LTD

HINCKLEY LEICESTERSHIRE

EMULSIFIERS · EMULSIONS READY FOR USE
WETTING AGENTS · SIZING ASSISTANTS
SOLUBLE WAXES · SULPHATED FATTY ALCOHOLS
DULLING AGENTS · WINDING AND KNITTING OILS
DETERGENTS · SOFTENING AGENTS

SAMPLES AND LITERATURE AVAILABLE

ALCOCK (PEROXIDE) LTD
LUTON BEDS

Telephone Luton 4900
Telegrams PEROXIDE LUTON

NOW AVAILABLE

SECOND EDITION REVISED AND ENLARGED

IDENTIFICATION OF DYES ON TEXTILE FIBRES

and

DETECTION OF METALS IN FIBROUS MATERIALS, DYES, AND ORGANIC PIGMENTS

by

ELLIS CLAYTON F.R.I.C

Price **10/6** *net*

Orders together with remittance should be sent to the

GENERAL SECRETARY
THE SOCIETY OF DYERS AND COLOURISTS
19 PICCADILLY BRADFORD
YORKSHIRE

Notice to Authors of Papers

The MSS. of all papers communicated to or read before the Society become the property of the Society. They should be addressed to the Editor, Society of Dyers and Colourists, 19 Piccadilly, Bradford. Authors must not allow their papers to be published elsewhere before they have appeared in the Society's *Journal*. Should prior publication take place without the sanction of the Publications Committee, the paper will be printed only as an abstract or summary.

Manuscripts submitted for publication in the *Journal* should be typewritten (double spacing) on good-quality paper, using one side of the paper only and leaving a margin at least 1 in. wide on the left-hand side. The time taken in refereeing papers (both lectures and communications) will be reduced to a minimum when authors submit two copies of the typescript.

In view of the high costs of publication, it is essential that authors should be as concise as possible. When experimental procedure has already been published, a literature reference to the paper containing the details is sufficient, whilst well known experimental methods should be described very briefly.

Introductory paragraphs describing the aims of the investigation and the method of attack are desirable, and should be followed by the experimental results and their discussion. There should be a brief summary for insertion at the beginning of the paper. References to the literature should be numbered consecutively, using superscript numbers without brackets immediately following the text words or author's name to which they refer.

The list of references should be given at the end of the manuscript and the abbreviations used should be, as far as possible, those given in the "List of Periodicals Abstracted" included at the end of the Index to the preceding year's *Journal*. Reference numbers in this list should be neither enclosed in brackets nor followed by full-stops. As far as possible throughout the manuscript the abbreviations listed in the Jan. 1950 issue (p. 54) should be used. Tables should be numbered consecutively in Roman numerals and Figures in Arabic numerals.

The number of figures and graphs should be kept as low as possible, and data should be presented in the form of either tables or graphs, not both. Drawings should be carefully prepared, preferably in Indian ink, on plain white drawing paper or, preferably, Bristol board. In graphs, the frame and actual curves should be ruled and inked more heavily than any co-ordinate lines, and the latter should not be close together as in ordinary graph paper. Experimental points should always be given, and where several graphs appear in a single Figure clear means of differentiation must be adopted. All numbers and legends are set up in type by the printer, and authors should therefore indicate them lightly in pencil.

Twenty-five free copies of a reprint are supplied to the author of an original paper published in the *Journal*, or fifty free copies are supplied when there are two or more authors, and a further number may be purchased from the Society at the rates given below.

REPRINTS OF LECTURES AND COMMUNICATIONS

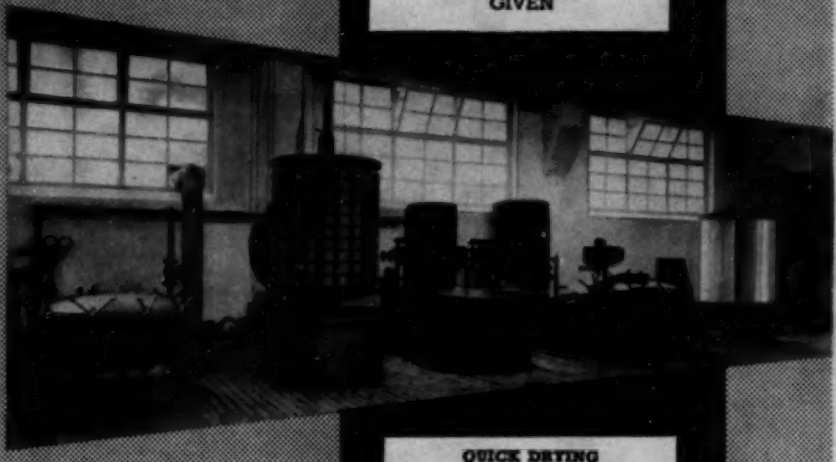
Reprints of all lectures and communications are available after publication to members and non-members of the Society. The charges (postage included) are as follows— Single copies 2s. 6d. each; per dozen copies up to and including 8 pages, 12s. 6d., and for papers occupying more than 8 pages of the *Journal*, 17s. Orders should be addressed to "The Society of Dyers and Colourists, 19 Piccadilly, Bradford". They can be accepted only if accompanied by remittance and if received immediately after publication of the paper.

THIES

PRESSURE DYEING AND BLEACHING

A universal dyeing and bleaching apparatus to take cones, cheeses, beams, loose material or card sliver.

QUICK DELIVERY GIVEN



QUICK DRYING

Drying apparatus to give controlled drying in up to 1½ hours.

ECONOMIC PRODUCTION BY LABOUR-SAVING MACHINERY

B. THIES

Represented by

JOHN GODRICH 22 Bennett's Hill BIRMINGHAM 2

PUBLISHED FOR THE SOCIETY AND PRINTED BY CHORLEY AND PICKERSGILL LTD LEEDS
ENTERED AT THE NEW YORK POST OFFICE AS SECOND CLASS MATTER